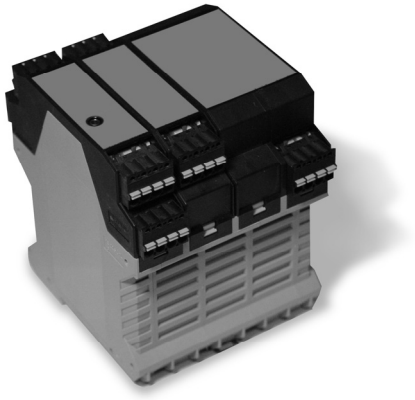
OMRON

User's Manual

F3SX

Safety Controller



J224I-E-01

Original instructions

Introduction

Thank you for purchasing the F3SX Series Safety Controller (hereinafter referred to as the “F3SX”).
This is the instruction Manual describing the use of F3SX.
Always heed the following points when using the F3SX:

- Be sure to have F3SX be handled by a "Responsible Person" who is well aware of and familiar with the machine to be installed.
- The term "Responsible Person" used in this Instruction Manual means the person qualified, authorized and responsible to secure "safety" in each process of the design, installation, operation, maintenance services and disposition of the machine.
- It is assumed that F3SX will be used properly according to the installation environment, performance and function of the machine. Responsible Person should conduct risk assessment on the machine and determine the suitability of this product before installation.
- Read this Manual thoroughly to understand and make good use of the descriptions before installing and operating the product.
- Keep this Manual at the place where the operator can refer to whenever necessary.

Introduction	**Precautions in using the Product** (Be sure to read it thoroughly.)
Chapter 1	Outline
Chapter 2	Specifications of Main Module
Chapter 3	Specifications of Output Module
Chapter 4	Specifications of Input Module
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User's Manual

Safety Controller
Model F3SX Series

Legislation and Standards

- In Japan, "Type Test" requirements are provided in Article 44 of the Industrial Safety and Health Law. These requirements apply to complete systems, and can not be applied to a controller by itself. Accordingly, in order to use the F3SX controller in Japan as a "Safety device for press machine or shearing tool" pursuant to Article 42 of the above-mentioned law, it is necessary to apply for testing of the entire system.

- In Europe, the F3SX controller is subject to the European Union (EU) Machinery Directive Annex V, Item 2 and 4.

- We have obtained the following certificate of TÜV-SÜD for F3SX.
  1) EC Declaration of Conformity
     OMRON declares that F3SX is in conformity with the requirements of the following EC Directives:
     - Machinery Directive 2006/42/EC
     - Low Voltage Directive 2006/95/EC
     - EMC Directive 2004/108/EC
  2) European standards EN61508 (SIL1-3), EN ISO13849-1:2008 (Cat.4 PL e), EN61496-1 (Type4 ESPE), EN50178, EN55011, EN60204-1, EN61000-6-2, EN61000-6-4, EN1760-1, EN574 (Type IIIC), EN1088
  3) International standards IEC61508 (SIL1-3), IEC61496-1 (Type4 ESPE), IEC60204-1

- We have obtained the following certificate of UL for F3SX.
  -Listing certificate for the safety standards of USA and Canada.
  UL508, UL1998, UL61496-1 (type4 ESPE), CSA C22.2 No.14, CSA C22.2 No.0.8

READ AND UNDERSTAND THIS MANUAL

Please read and understand this manual before using the products. Please consult your OMRON representative if you have any questions or comments.

WARRANTY

OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.

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OMRON SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

In no event shall responsibility of OMRON for any act exceed the individual price of the product on which liability is asserted.

IN NO EVENT SHALL OMRON BE RESPONSIBLE FOR WARRANTY, REPAIR, OR OTHER CLAIMS REGARDING THE PRODUCTS UNLESS OMRON'S ANALYSIS CONFIRMS THAT THE PRODUCTS WERE PROPERLY HANDLED, STORED, INSTALLED, AND MAINTAINED AND NOT SUBJECT TO CONTAMINATION, ABUSE, MISUSE, OR INAPPROPRIATE MODIFICATION OR REPAIR.

SUITABILITY FOR USE

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the product.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this document.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
- Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.

NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCT IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

CHANGE IN SPECIFICATIONS

Product specifications and accessories may be changed at any time based on improvements and other reasons. Consult with your OMRON representative at any time to confirm actual specifications of purchased product.

DIMENSIONS AND WEIGHTS

Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

ERRORS AND OMISSIONS

The information in this document has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proofreading errors, or omissions.

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Precautions for Safe Use

Regarding the alert symbols and meanings used for the safe uses

In order for our customers to use F3SX in safety, precautions are indicated in this manual with the alert symbols and statements such as the followings. Those safety precautions relate to the important descriptions that must be obeyed for the safe uses and operations. Be sure to obey the precautions.
The following indications and symbols are used for the descriptions.

⚠WARNING	Indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury, or may result in serious injury or death. Additionally there may be significant property damage.

⚠CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or in property damage.

Meanings of Alert Symbols

	Indicates prohibited actions.

	Indicates mandatory actions.

Alert Statements in this Manual

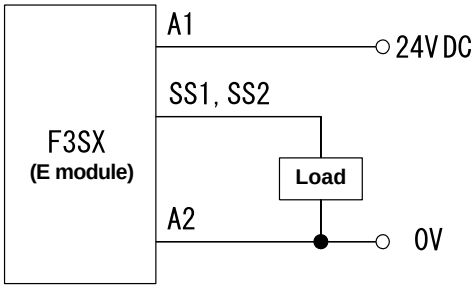
⚠WARNING	
Do not disassemble, modify, or attempt to repair the F3SX controller. Doing so may damage the original safety functions.	
Do not operate the F3SX controller in a hazardous environment, such as an environment that contains flammable or explosive gas. Doing so may cause fire or explosion by electric arc generated in the internal relays or externally connected electromagnetic switches.	
Do not connect the F3SX power input with a DC power supply or AC power supply exceeding the rated voltage. Also do not make reverse connection for the polarity of power supply. Doing either of these may cause breakdown of device and/or danger such as an electric shock.	
Do not use the F3SX's communication functions for the purpose of configuring a safety related system. Doing so may cause serious danger if any trouble occurs with the wiring or programming of the host computer.	

⚠WARNING	
Do not use the auxiliary input terminals (start command input) for connection with a safety input device for the purpose of configuring a safety related system. Doing so may cause serious injury to humans when a trouble occurs with F3SX or the peripheral devices.	
Apply neither of a voltage exceeding the rated nor an AC power supply across the auxiliary input terminals (start command inputs). Doing either of these may cause breakdown of device and/or danger such as an electric shock.	
The auxiliary solid-state output (at the AS1,AS2 and AS3 terminals) is not a safety output. Do not use it for the purpose of configuring a safety related system. Doing so may cause serious injury to humans when a trouble occurs with F3SX or the peripheral devices.	
The external indicator output is not a safety output. Do not use it for the purpose other than indication.	
DC solid-state safety output; Do not short-circuit the output lines to the 24V DC line. Doing so will make the output always ON and dangerous. Also, ground the 0V line of the power source so that the output does not become ON when the output line is grounded.	
Never use with a load in excess of the trip capacity (contact voltage, contact current). Doing so may damage the output circuit and cutoff may not be possible.	
When transferring a F3SX product to another user, be sure to attach this User's Manual.	
When this product is used in a safety related system, a "Responsible Person" must strictly conform to the standards, legislations and regulations of the country and the local government under which the system is operated.	
A "Responsible Person" who is well aware of and familiar with the machine must implement the installation of the F3SX and confirmation thereafter. And the users must have thorough understanding about the relevant installation requirements, safe distances, control devices and the functions before starting operation.	
For the inspection and/or maintenance of the F3SX, a "Responsible Person" must confirm that the work has been properly performed. Maintenance Services and Inspection p.6-30	
In order to prevent hazardous situation, a "Responsible Person" must implement the inspections according to this User's Manual at least once for every six months. Failure to do so may leads to an accident including a serious injury to humans.	
Whenever the F3SX does not operate properly, the user shall stop the machine immediately and report it to the "Responsible Person".	

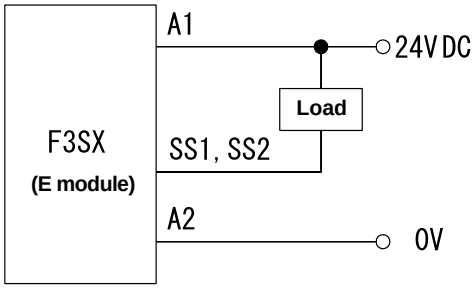
⚠WARNING	
In order for F3SX to satisfy EN60204-1, IEC61496-1 and UL508, have the DC power unit comply with all of the following requirements. • Voltage within the rated (24V DC ± 10%). • Do not share the power source with other devices or machines. When the power source is shared by multiple devices, consider margins for the total rated current. • Compliant with the EMC Directive, for Industrial environments. • Double or reinforced insulation between the primary and secondary circuits. • Automatic recovery of over-current protection characteristics (voltage drop). • 20ms or over of the output hold time. • Satisfies the output characteristics requirements of a class 2 circuit or equivalent limited energy circuit, as stipulated in UL508. • Compliant with the laws and standards in relation to EMC and other electric device safety in the country or area where this unit is used. (Example: EMC Directive and Low Voltage Directive in EU.)	
When using a commercialized switching regulator, be sure to ground FG (frame ground terminal). (If not grounded, it may cause erroneous operations due to the switching noises.)	
Use appropriate control devices to materialize the safety functions. Failure to do so may cause deterioration in the safety performances.	
Wiring must be done while the power is turned OFF either for F3SX or the devices connected with it. Doing it with the power ON may cause an electric shock. And external devices in connection with this product may behave in an unexpected way.	
Ensure that the connections are made properly at the input and output terminals. Failure to ensure this may cause an electric shock or damage the safety functions.	
Ensure that sufficient attention is given so that shared causes of faults do not cause the redundant safety circuit to become ineffective.	
Set up a protective structure around the applicable machines so that nobody can reach the hazardous area of the machines without passing through the detection zone. If any works should be carried out in such hazardous area, set the sensors that always detect whole or a part of human bodies. Failure to do so causes the detection errors of human body and will lead to a serious injury.	
Measure the maximum stop time with the actual machine configurations and periodically confirm that the stop time remains unchanged.	
Never fail to secure the safety distances to the hazardous areas around the machine.	
The reset switch must be installed in a place where the entire dangerous zone can be viewed, and in a way that the switch cannot be operated from the dangerous zone.	
In order to maintain the safety functions, put the product in the state of output-OFF (the emergency-stop state) once every 24 hours.	

⚠WARNING	
Do not use F3SX for the machines that cannot be stopped immediately by the electric control at an emergency. Such machines cannot stop before the human body reaches the hazardous area and will cause a serious injury.	
With regard to the relay output, install a fuse in serial with the output contacts. Contacts protection for safety relay outputs p.14	
Be sure to align the devices so as to prevent mutual interference when using multiple safety light curtains or multi-beam safety sensors. Failure to do so may cause non-detectable conditions and a serious injury to humans.	
Regarding setting to F3SX by using the function set-up software for model F3SX (Model F3SX-CD□□□, sold separately), keep the set contents in the history.	
After changing any settings to F3SX by using the function set-up software for model F3SX (Model F3SX-CD□□□, sold separately), be sure to carry out the "Function test" and keep the test results in the history. Function test p.6-30	
DC solid-state safety output; Be sure to configure the safety related system by using two channels. Only with one channel to be used, the safety functions of the system will be degraded. It may cause serious injury to humans when a trouble occurs.	
DC solid-state safety output; Connect a load across the output terminal and the 0V line (PNP output). If it is connected between the output terminal and the 24V DC line by mistake, the output may turn ON when an emergency-stop occurs and cause a dangerous situation.	

(Correct)



(Wrong)



⚠ CAUTION	
The safety category is determined by the entire safety control system. Design and use it in accordance with all the related standards. Consultation with an independent certification organization is recommended.	
The life duration of the relays varies depending on the switching conditions or loads, etc. Use the relays within an appropriate switching times, after confirming the limit of switching times with the actual devices under the actual conditions.	
If the DIN rail is too short for the width of F3SX, the product may drop out of the rail by vibration. Use end plate (Model PFP-M, sold separately), to fix F3SX on the DIN rail where necessary.	
Use F3SX in an enclosure rated at least IP54 (IEC60529).	
For ventilation, allow for 5mm or more on both sides of the F3SX and 50mm or more above and beneath.	
Stranded wire should be processed with insulation-covered bar terminal (DIN46228-4 standard compatible type) at its ends before using for connection. Conforming wire (when using recommended bar terminals): 0.34 to 1.5mm^2 AWG22 to 16	
Be careful not to catch a finger in the connector when installing it.	
Connect firmly at the time of main body mounting and connect the cable connectors.	
Allow some leeway for the wires and do not tighten the wires when wiring connection cables to F3SX, and confirm that any cable may not block the movements of workers or objects.	
For the external indicator, use a filament-type lamp for the externally connected indicator. With an LED-type indicator, the perfect detection of a trouble is not available.	
Mat must be installed on a flat floor.	

Precautions for Safe Use

Please observe the following precautions for safe use of the products.

(1) Read this manual thoroughly to understand before using the product.

(2) Loads must satisfy all the conditions below:
- •Are not short-circuited.
- •Are not provided with the voltage higher than the rating.
- •Are not used with current higher than the rating.

(3) Provide the control circuit (24V DC circuit) of F3SX with double or reinforced insulation for protection from an electric shock. (Conforming to Standards p.13)

(4) F3SX belongs to the over-voltage category II. Connect F3SX to the power distribution system of the over-voltage category II.
(Conforming to Standards p.13)

(5) Ground the minus terminal of 24V DC for the D-class earthing (through the earthing resistance of 100Ω max.).

(6) Put the product in the state of output-OFF (the emergency-stop state) once every 24 hours.

(7) Do not disassemble, repair or modify F3SX.

(8) Be sure to dispose of the F3SX as industrial waste.

Precautions for Correct Use

Please observe the following precautions to prevent operation failure, malfunctions, or undesirable effects on product performance.

(1) Installation environment:
-Do not use F3SX at altitudes over 1,000 meters.
-Do not install the F3SX in the following environments:
•Areas with high-humidity where condensation is likely to occur;
•In the atmosphere with smoke or microparticles which may cause quality deterioration;
•In the atmosphere of corrosive, inflammable or explosive gases;
•Areas exposed to vibration or shock levels higher than specification provisions;
•Areas where the product may come in direct contact with water, oil, chemicals;
•Areas subject to oscillation or impact larger than rated value;
-Do not use radio equipment, such as cellular phones, walkie-talkies or transceivers which generate radio waves, near the F3SX.
-Protect the output circuit with a surge absorber when an inductive load is connected to the output.
-For ventilation and wiring, allow for 5mm on both sides of the F3SX, and 50mm or more above and beneath.

(2) Wiring and mounting
-Do not operate the control system until 5 seconds or more after turning ON the power of the F3SX.
-Do not have the input/output lines, such as that for sensor, share the same conduit with the high voltage or power electric lines.
-When replacing the metal connectors with other types such as resin connectors, use ones in the structure with the protection grade IP54 or higher.
-Wire correctly after confirming the signal names of all the terminals.
-Perform wiring between the input and output with a wiring length of 100m or less. When regulations specify that the wiring of a connected device must be 100m or less, perform wiring according to those regulations.

(3) Maintenance
-When cleaning, avoid using thinner, benzene or acetone.

(4) Standards
-The safety category is determined by the entire safety control system. Design and use it in accordance with all the related standards. Consultation with an independent certification organization is recommended.
-The customer is requested to make compliant with the applicable standards for the entire system.

(5) This is a class A product. In residential areas it may cause radio interference, in which case the Responsible Person may be required to take adequate measures to reduce interference.

Conforming to Standards

Regarding Over-voltage Category

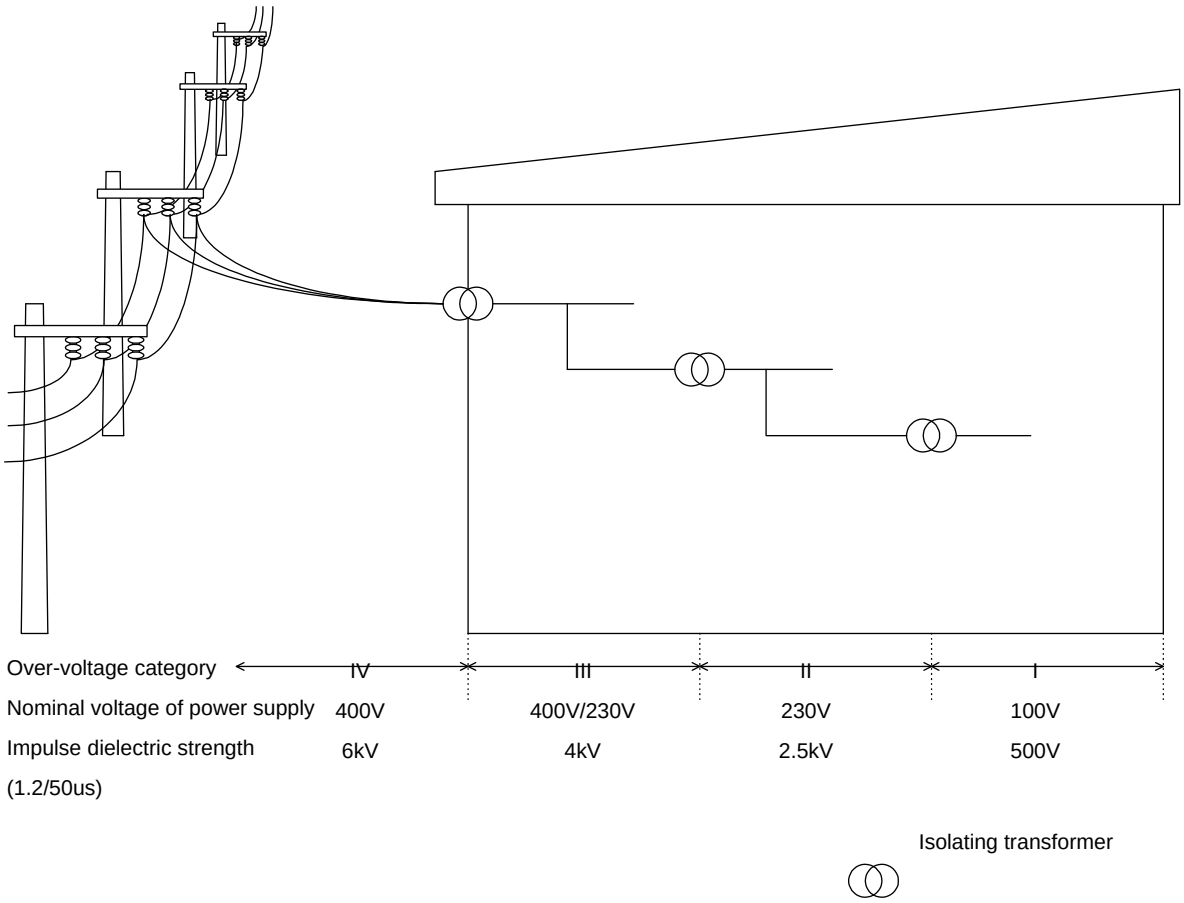


Fig.1 Example of over-voltage category (1).

Over-voltage category is the classification which categorizes the power distribution system by the required impulse withstand level caused by such as a lightning. Categories are defined from IV to I in order of impulse voltage level as shown in Fig.1.

F3SX is designed for over-voltage category II based on EN50178. Therefore, do not connect F3SX directly to the power distribution system whose over-voltage category is III or over.

In general, over-voltage category II is the power distribution system that is insulated and stepped down voltage level with more than two isolating transformers from the public power distribution system.

See IEC60664-1, EN50178 for details of the over-voltage category.

Isolating transformers

The isolating transformer that is used to isolate between over-voltage category III and II such as TR1 of Fig.2 should conform to IEC60742, and the insulation between first input and secondary output should satisfy at least basic insulation of over-voltage category III.
One side of a secondary output of the isolating transformer should be grounded for the protection in a case a short-circuit failure occurs between input and output of the isolating transformer.
Insert fuses to protect the isolating transformer and to prevent personnel from an electrical shock according to the specification of the transformer, i.e. at the points of F1, F2, F3 of Fig.2.

Contacts protection for electro-magnetic contactors

For the use of safety category 4 (EN ISO13849-1:2008), insert fuses at F6, F7, and F8 of Fig.2 whose current rating is less than 60% of the current rating of electromagnetic contactors to protect contacts from welding according to prEN50156. But if the prospective short-circuit current is less than the current rating of electromagnetic contactors, this may not be required.
If contacts are welded, it may cause an opening failure of outputs. For the details, see chapter prEN50156-1of 10.4.3.4.

Contacts protection for safety relay outputs

For the use of safety category 4 (EN ISO13849-1:2008), insert fuses at F4 and F5 of Fig.2 whose current rating is less than 3.15A to protect safety relay output contacts from welding according to prEN50156. If fuses with current rating of more than 3.15A are used, fault exclusion of contact welding becomes impossible.
If the application is intended for use under safety category 3 (EN ISO13849-1:2008), insert fuses at F4 and F5 of Fig.2 whose current rating is less than 5A, and safety relay outputs are possible to be applied with 5A max. (resistive load). But in this case, output relay contacts are not protected from welding.
If the safety relay contacts are welded, it may cause an opening failure of outputs.
For the details, see chapter prEN50156-1of 10.4.3.4.
If surge absorbers are used, they must be installed across the load as illustrated at SA1 and SA2 of Fig.2. If it was installed directly across the output, it may cause a failure to open output circuits.

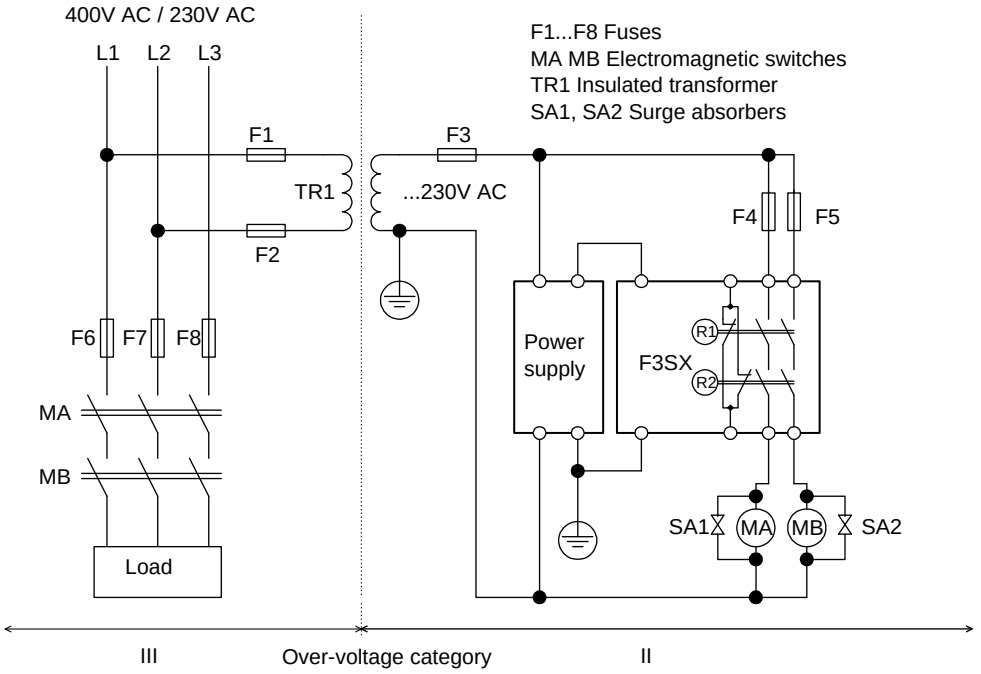


Fig.2 Example of over-voltage category (2).

How to Read This Manual

Meaning of marks

Indicates descriptions of essential points regarding the performance such as an advice for use.

Indicates the page number for the relevant contents.

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Outline

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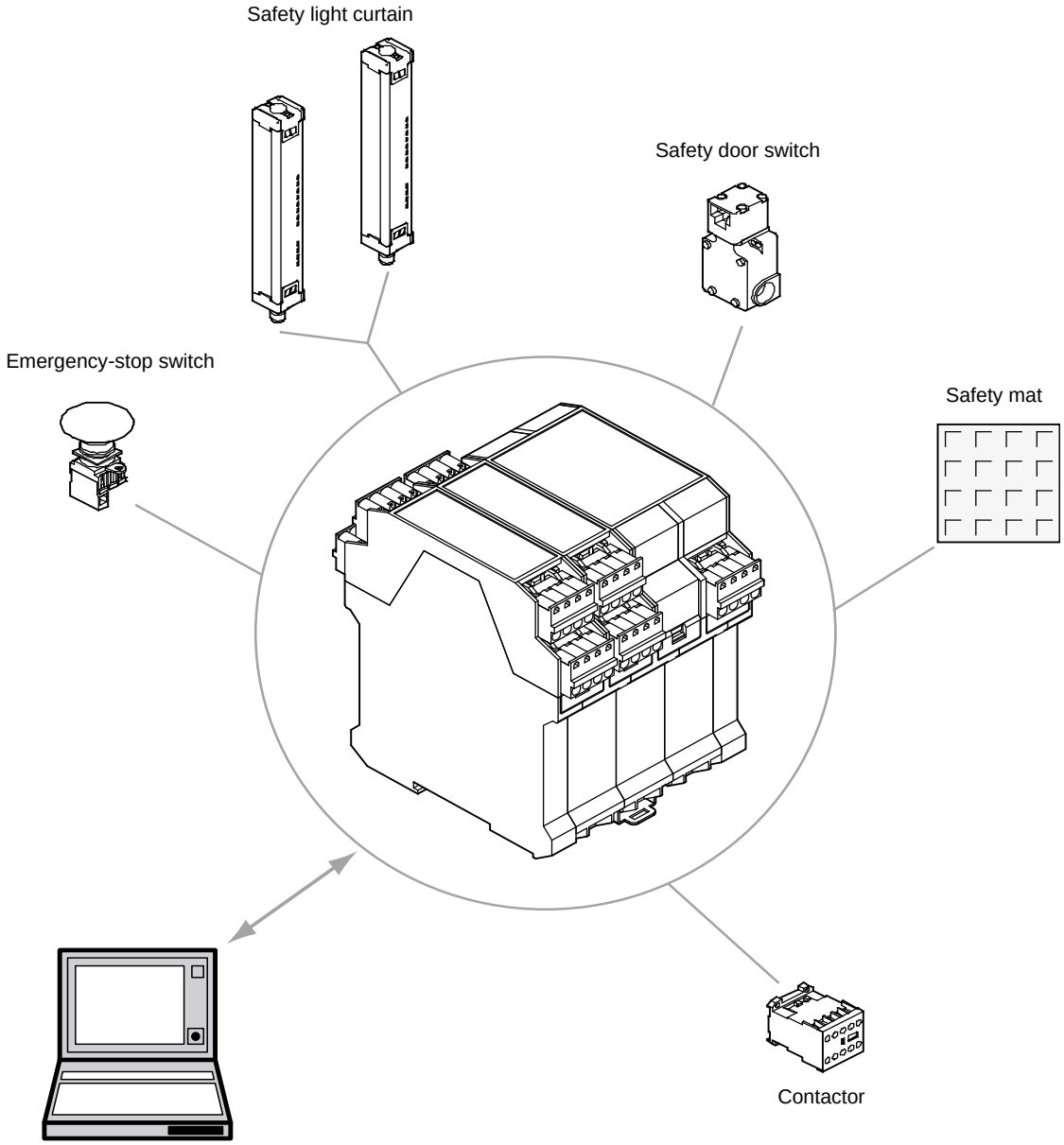
Features of F3SX

- F3SX is an electronic safety controller.
  Applicable to the performance level (PL) a, b, c, d, or e, and stop category 0, 1.
- It is composed by modules.

Main Module	.....	controls the entire part of controller.	(Two kinds)
Input Module	.....	to be connected with the input devices such as safety light curtains, safety mat, etc.	(Three kinds)
Relay Output Module	.....	functions as the safety outputs.	(Three kinds)

- Multiple input devices can be connected to a single unit of controller.
  The products can be chosen in compatibility with the applications.
- By using the function set-up software for model F3SX (Model F3SX-CD□□□, sold separately), changes in various kinds of parameters and input/output terminal monitoring of F3SX can be performed.



■ Control Devices to Be Connected

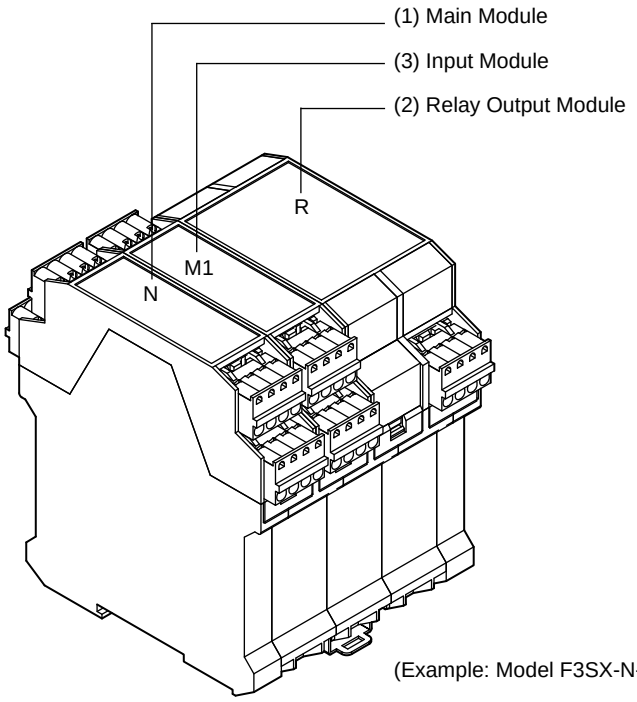
⚠WARNING

In order to maintain the correct operation of all safety functions, use appropriate devices for connection with the product. Failure to do so may cause degradation of the safety functions.

Control device	Requirements
Emergency-stop switch Door interlock switch	Use the switch of positive opening operation complying with IEC/EN60947-5-1. Also, use the parts having been approved by the certification body. Use the door interlock switch satisfying the required safety category. Use the switch compatible with the load of small current (24V DC, 5mA).
Safety mat	Use Miller Edge Model ME151-4/ME151Y-4 manufactured.
Safety light curtain	Use OMRON Model F3SN/F3SH/F3SJ series manufactured.
Relay Electromagnetic breaker	Use those with forcibly guided (linked) contacts or those conforming to EN50205. If connecting the NC contact of an electromagnetic breaker without the forcibly guided (linked) contacts to the feedback/reset input line, inability in declinator contact of such electromagnetic breaker cannot be found out. Use those having been approved by the certification body. The feedback contacts should be compatible with the load of small current (24V DC, 5mA).
Other control devices	Use upon confirming that each of those satisfies the required safety category.

Module Configuration

F3SX main body consists of multiple module. The module is categorized in three types below.



(Example: Model F3SX-N-M1R)

Number / Module name	Description
(1) Main Module (E, N)	• One module is installed in a product for entire controlling on the controller. • Can be connected to an emergency-stop switch for the input device. • Can be connected to an external indicator. (N module : Main module with external indicator output) • Two channels of DC solid-state safety output are provided. (E module : Main module with DC solid-state safety output)
(2) Relay Output Module (R, R1, R2)	• The safety output functions are provided. Two channels of NO contact (conductive to output) and one channel of NC contact (non-conductive to ouput) are provided per module. • The installed number differs depending on the model.
(3) Input Module (M1, L2, D1)	• To be connected to the safety input devices such as safety light curtain, safety door switch, safety mat, etc. • The installed number differs depending on the model.

CHECK!

•The module alignment differs depending on the main body model.
•The maximum number of modules differs depending on the combined modules.
•External dimensions differ depending on the number of modules.

Dimensional Drawings p.1-13

Product Lineup

F3SX is categorized as follows.

Meanings of model type

Model F3SX-□□□

(1)

Number	Symbol	Meanings
(1)	EM1	Emergency-stop / controller for safety mat input (DC solid-state safety output)

Model F3SX-□-□□

(1) (2)

Number	Symbol	Meanings
(1)	N	Main module with external indicator output
	E	Main module with DC solid-state safety output
(2)	M1	Module for safety mat input
	L2	Module for light curtain input
	D1	Module for door switch input
	R	Relay output module (DPST-NO, SPST-NC) NON-delay output (Instant breaking) (delay time unable to be set)
	R1	Relay output module (DPST-NO, SPST-NC) ON-delay output
	R2	Relay output module (DPST-NO, SPST-NC) OFF-delay output

Rating / Characteristic

■ General specifications

Items	Rating / Characteristic
Category, Performance Level (PL) (EN ISO13849-1:2008)	Performance Level (PL) d, category 3.
Safety integrity level (IEC61508)	SIL3 (Note 1)
Rated supply voltage	24V DC ± 10% (ripple p-p 10% max.)
Startup time	5 seconds max.
Protection for control circuit	Output short-circuiting protection, and power supply reverse polarity protection. (Note 2)
Over-voltage category (IEC60664-1)	II
Insulation resistance	Between all lead wires and outer case : 100MΩ or more (by 500V DC megger)
Dielectric strength	Between all lead wires and outer case : 2200V AC, 50/60Hz for 1 min.
Ambient temperature	Operating : -10 to +50°C (no freezing or condensation) Storage : -30 to +70°C (no freezing or condensation)
Ambient humidity	Operating and storage : 35 to 85%RH each (no freezing or condensation)
Vibration resistance	10 to 55Hz double amplitude of 0.7mm each in X, Y and Z direction, 20 sweeps (with power on)
Shock resistance	100m/s^2 each in X, Y and Z direction, 1,000 times (with power on)
Case materials	Glass fiber reinforced polyamide 66 (PA-66-FR)
Degree of protection	Terminal block : IP20, Main body : IP40 (IEC60529)

(Note 1) This is the SIL value, but not a value of the entire system.

(Note 2) When this protection function operates, recover by turning the main power ON again.

■ Rated current, response time, mass, external dimension

[F3SX-EM1]

Input	Emergency-stop input	ON : 15 to 24V DC ± 10% OFF : Open or 0 to 5V DC Internal impedance : Approximately 5kΩ
	Reset input	
	Feedback input	
	Auxiliary input	
DC solid-state output	Safety output	PNP transistor output Load current 300mA max. (resistive load/inductive load) (Note 1) Residual voltage (for ON) : 2V max. (Note 2) Residual voltage (for OFF) : 0.1V max. Leakage current (for OFF) : 0.1mA max. Permissible capacity load : 1 μF max. Allowable wiring resistance between output terminal and load : 4 Ω max.
	Auxiliary solid-state output	PNP transistor output Load current : 25mA max., Residual voltage : 2V max. (Note 2)
Category, Performance Level (PL) (EN ISO13849-1:2008)		Performance Level (PL) d, category 3.
Safety integrity level (IEC61508)		SIL3
Rated current		300mA or less (except current consumption for the connected input/output devices)
Response time	DC solid-state safety output (SS1, SS2 terminal) Safety output monitor (AS1 terminal)	ON→OFF : 25 ms or less OFF→ON : 105 ms or less
Weight		Approximately 0.3kg (main body only)
External shape		2 slots : 45(W) x 111(H) x 113(D)
Connectable input devices		Emergency-stop switch (common to Ch.1 and Ch.2) Safety mat 2 connection area (Note 3)

(Note 1) Insert a surge absorber such as diode in parallel to the inductive load.

(Note 2) Not including voltage drops in the extended wire.

(Note 3) To connect more than 1 mat to 1 connection area:

(1) Total capacity of mats and connection cable must be maximum capacity of controller inputs or less.

(2) Mat connection cable length must be 100m or less.

(3) Capacity for reference

- Mat capacity: 1nF per square foot
- Mat connection cable (AWG16): 50pF per foot
- Maximum capacity of controller inputs: 0.09μF

[F3SX-E-M1M1]

Input	Emergency-stop input	ON : 15 to 24V DC ± 10% OFF : Open or 0 to 5V DC Internal impedance : Approximately 5kΩ
	Reset input	
	Feedback input	
	Auxiliary input	
DC solid-state output	Safety output	PNP transistor output Load current 300mA max. (resistive load/inductive load) (Note 1) Residual voltage (for ON) : 2V max. (Note 2) Residual voltage (for OFF) : 0.1V max. Leakage current (for OFF) : 0.1mA max. Permissible capacity load : 1 μF max. Allowable wiring resistance between output terminal and load : 4 Ω max.
	Auxiliary solid-state output	PNP transistor output Load current : 25mA max., Residual voltage : 2V max. (Note 2)
Category, Performance Level (PL) (EN ISO13849-1:2008)		Performance Level (PL) d, category 3.
Safety integrity level (IEC61508)		SIL3
Rated current		450mA or less (except current consumption for the connected input/output devices)
Response time	DC solid-state safety output (SS1, SS2 terminal) Safety output monitor (AS1 terminal)	ON→OFF : 25 ms or less OFF→ON : 105 ms or less
Weight		Approximately 0.4kg (main body only)
External shape		3 slots : 67.5(W) x 111(H) x 113(D)
Connectable input devices		Emergency-stop switch (common to Ch.1 and Ch.2) Safety mat 4 connection area (Note 3)

(Note 1) Insert a surge absorber such as diode in parallel to the inductive load.

(Note 2) Not including voltage drops in the extended wire.

(Note 3) To connect more than 1 mat to 1 connection area:

(1) Total capacity of mats and connection cable must be maximum capacity of controller inputs or less.

(2) Mat connection cable length must be 100m or less.

(3) Capacity for reference

- Mat capacity: 1nF per square foot
- Mat connection cable (AWG16): 50pF per foot
- Maximum capacity of controller inputs: 0.09μF

[F3SX-E-L2M1]

Input	Emergency-stop input	ON : 15 to 24V DC ± 10% OFF : Open or 0 to 5V DC Internal impedance : Approximately 5kΩ
	Reset input	
	Feedback input	
	Auxiliary input	
DC solid-state output	Safety output	PNP transistor output Load current 300mA max. (resistive load/inductive load) (Note 1) Residual voltage (for ON) : 2V max. (Note 2) Residual voltage (for OFF) : 0.1V max. Leakage current (for OFF) : 0.1mA max. Permissible capacity load : 1 μF max. Allowable wiring resistance between output terminal and load : 4 Ω max.
	Auxiliary solid-state output	PNP transistor output Load current : 25mA max., Residual voltage : 2V max. (Note 2)
Category, Performance Level (PL) (EN ISO13849-1:2008)		Performance Level (PL) d, category 3.
Safety integrity level (IEC61508)		SIL3
Rated current		450mA or less (except current consumption for the connected input/output devices)
Response time	DC solid-state safety output (SS1, SS2 terminal) Safety output monitor (AS1 terminal)	ON→OFF : 25 ms or less OFF→ON : 105 ms or less
Weight		Approximately 0.4kg (main body only)
External shape		3 slots : 67.5(W) x 111(H) x 113(D)
Connectable input devices		Emergency-stop switch (common to Ch.1 and Ch.2) Safety mat 2 connection area (Note 3) Safety light curtain 2 set

(Note 1) Insert a surge absorber such as diode in parallel to the inductive load.

(Note 2) Not including voltage drops in the extended wire.

(Note 3) To connect more than 1 mat to 1 connection area:

(1) Total capacity of mats and connection cable must be maximum capacity of controller inputs or less.

(2) Mat connection cable length must be 100m or less.

(3) Capacity for reference

- Mat capacity: 1nF per square foot
- Mat connection cable (AWG16): 50pF per foot
- Maximum capacity of controller inputs: 0.09μF

[F3SX-E-M1D1]

Input	Emergency-stop input	ON : 15 to 24V DC ± 10% OFF : Open or 0 to 5V DC Internal impedance : Approximately 5kΩ
	Reset input	
	Feedback input	
	Auxiliary input	
DC solid-state output	Safety output	PNP transistor output Load current 300mA max. (resistive load/inductive load) (Note 1) Residual voltage (for ON) : 2V max. (Note 2) Residual voltage (for OFF) : 0.1V max. Leakage current (for OFF) : 0.1mA max. Permissible capacity load : 1 μF max. Allowable wiring resistance between output terminal and load : 4 Ω max.
	Auxiliary solid-state output	PNP transistor output Load current : 25mA max., Residual voltage : 2V max. (Note 2)
Category, Performance Level (PL) (EN ISO13849-1:2008)		Performance Level (PL) d, category 3.
Safety integrity level (IEC61508)		SIL3
Rated current		450mA or less (except current consumption for the connected input/output devices)
Response time	DC solid-state safety output (SS1, SS2 terminal) Safety output monitor (AS1 terminal)	ON→OFF : 25 ms or less OFF→ON : 105 ms or less
Weight		Approximately 0.4kg (main body only)
External shape		3 slots : 67.5(W) x 111(H) x 113(D)
Connectable input devices		Emergency-stop switch (common to Ch.1 and Ch.2) Safety mat 2 connection area (Note 3) Safety door switch (common to Ch.1 and Ch.2) 2sets

(Note 1) Insert a surge absorber such as diode in parallel to the inductive load.

(Note 2) Not including voltage drops in the extended wire.

(Note 3) To connect more than 1 mat to 1 connection area:

(1) Total capacity of mats and connection cable must be maximum capacity of controller inputs or less.

(2) Mat connection cable length must be 100m or less.

(3) Capacity for reference

- Mat capacity: 1nF per square foot
- Mat connection cable (AWG16): 50pF per foot
- Maximum capacity of controller inputs: 0.09μF

[F3SX-E-M1R]

Input	Emergency-stop input			ON : 15 to 24V DC ± 10% OFF : Open or 0 to 5V DC Internal impedance : Approximately 5kΩ
	Reset input			
	Feedback input			
	Auxiliary input			
DC solid-state output	Safety output			PNP transistor output Load current 300mA max. (resistive load/inductive load) (Note 1) Residual voltage (for ON) : 2V max. (Note 2) Residual voltage (for OFF) : 0.1V max. Leakage current (for OFF) : 0.1mA max. Permissible capacity load : 1 μF max. Allowable wiring resistance between output terminal and load : 4 Ω max.
	Auxiliary solid-state output			PNP transistor output Load current : 25mA max., Residual voltage : 2V max. (Note 2)
Relay contact output	Number of main contacts (safety outputs)			DPST-NO
	Number of auxiliary contacts			SPST-NC
	Rated load	Resistive load	11/12 terminal (Auxiliary contact)	250V AC 50/60Hz 30V DC 5A
			23/24 terminal 33/34 terminal (Main contact)	250V AC 50/60Hz 30V DC 3.15A (5A) (Note 3)
		Inductive load		AC-15 : 240V AC/2A cosϕ=0.3 DC-13 : 24V DC/1A L/R=48ms
	Minimum applicable load (Note 4)			24V DC/5mA (reference value) (Note 5)
	Electrical endurance (Note 4)			100,000 times or more (open/close frequency of 1,800 times/h)
	Mechanical endurance (Note 4)			10,000,000 times or more (open/close frequency of 36,000 times/h)
Category, Performance Level (PL) (EN ISO13849-1:2008)				Performance Level (PL) d, category 3.
Safety integrity level (IEC61508)				SIL3
Rated current				400mA or less (except current consumption for the connected input/output devices)
Response time	Instant breaking auxiliary output (AS1 terminal)			ON→OFF : 25 ms or less OFF→ON : 105 ms or less
	Safety relay output (23/24 terminal, 33/34 terminal) Auxiliary relay output (11/12 terminal)			Response time : 35 ms or less Operating time : 135 ms or less
Weight				Approximately 0.5kg (main body only)
External shape				4 slots : 90(W) x 111(H) x 113(D)
Connectable input devices				Emergency-stop switch (common to Ch.1 and Ch.2) Safety mat 2 connection area (Note 6)

(Note 1) Insert a surge absorber such as diode in parallel to the inductive load.

(Note 2) Not including voltage drops in the extended wire.

(Note 3) An external fuse must be inserted into the safety relay output. The fuse rating depends on the safety category.
Use under the Safety category 3 (EN ISO13849-1:2008)
The external fuse rating is 5A or less than 5A. The current that can be applied to the safety relay contacts is limited by the fuse rating and it is 5A or less than 5A (resistive load). However, in this case, the safety relay output cannot be protected from welding.
For the details, see the section 10.4.3.4 of prEN50156-1.

(Note 4) Performance of the built-in relay itself. * The values for endurance are those at ambient temperatures between +15 and +35°C and ambient humidities between 25 to 75%RH.

(Note 5) Reference value. Use with less value is not appropriate. Note that, if loaded once with a higher value, the contacts may become unable to open/close for a small load.

(Note 6) To connect more than 1 mat to 1 connection area:
(1) Total capacity of mats and connection cable must be maximum capacity of controller inputs or less.
(2) Mat connection cable length must be 100m or less.
(3) Capacity for reference
- Mat capacity: 1nF per square foot
- Mat connection cable (AWG16): 50pF per foot
- Maximum capacity of controller inputs: 0.09μF

[F3SX-N-M1R]

Input	Emergency-stop input			ON : 15 to 24V DC ± 10% OFF : Open or 0 to 5V DC Internal impedance : Approximately 5kΩ
	Reset input			
	Feedback input			
	Auxiliary input			
DC solid-state output	External indicator output (Note 1)			External indicator which can be connected Filament type indicator DC24V, 3 to 7W
	Auxiliary solid-state output			PNP transistor output Load current : 25mA or under, Residual voltage : 2V or under (Note 2)
Relay contact output	Number of main contacts (safety outputs)			DPST-NO
	Number of auxiliary contacts			SPST-NC
	Rated load	Resistive load	11/12 terminal (Auxiliary contact)	250V AC 50/60Hz 30V DC 5A
			23/24 terminal 33/34 terminal (Main contact)	250V AC 50/60Hz 30V DC 3.15A (5A) (Note 3)
		Inductive load		AC-15 : 240V AC/2A cosϕ=0.3 DC-13 : 24V DC/1A L/R=48ms
	Minimum applicable load (Note 4)			24V DC/5mA (reference value) (Note 5)
	Electrical endurance (Note 4)			100,000 times or more (open/close frequency of 1,800 times/h)
	Mechanical endurance (Note 4)			10,000,000 times or more (open/close frequency of 36,000 times/h)
Category, Performance Level (PL) (EN ISO13849-1:2008)				Performance Level (PL) d, category 3
Safety integrity level (IEC61508)				SIL3
Rated current				400mA or less (except current consumption for the connected input/output devices)
Response time	Instant breaking auxiliary output (AS1 terminal)			ON→OFF : 25 ms or less OFF→ON : 105 ms or less
	Safety relay output (23/24 terminal, 33/34 terminal) Auxiliary relay output (11/12 terminal)			Response time : 35 ms or less Operating time : 135 ms or less
Weight				Approximately 0.5kg (main body only)
External shape				4 slots : 90(W) x 111(H) x 113(D)
Connectable input devices				Emergency-stop switch (common to Ch.1 and Ch.2) Safety mat 2 connection area (Note 6)

(Note 1) If no external indicator is connected, connect a resistor (4.7kΩ, 1/4W) between the EL1 and EL2 terminals.

The resistor with lead wires (non-polar) shown in the right figure is attached to this product.

(Note 2) Not including voltage drops in the extended wire.

(Note 3) An external fuse must be inserted into the safety relay output. The fuse rating depends on the safety category.
Use under the Safety Category 3 (EN ISO13849-1:2008)
The external fuse rating is 5A or less than 5A. The current that can be applied to the safety relay contacts is limited by the fuse rating and it is 5A or less than 5A (resistive load). However, in this case, the safety relay output cannot be protected from welding.
For the details, see the section 10.4.3.4 of prEN50156-1.

(Note 4) Performance of the built-in relay itself. * The values for endurance are those at ambient temperatures between +15 and +35°C and ambient humidities between 25 to 75%RH.

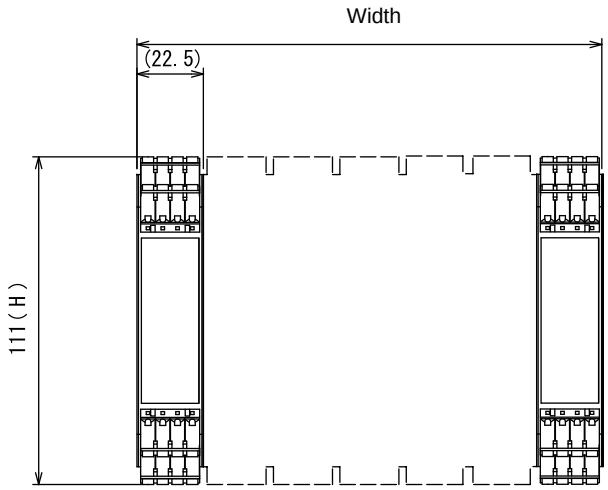
(Note 5) Reference value. Use with less value is not appropriate. Note that, if loaded once with a higher value, the contacts may become unable to open/close for a small load.

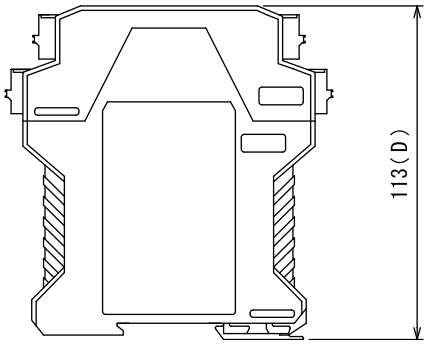
(Note 6) To connect more than 1 mat to 1 connection area:
(1) Total capacity of mats and connection cable must be maximum capacity of controller inputs or less.
(2) Mat connection cable length must be 100m or less.
(3) Capacity for reference
- Mat capacity: 1nF per square foot
- Mat connection cable (AWG16): 50pF per foot
- Maximum capacity of controller inputs: 0.09μF

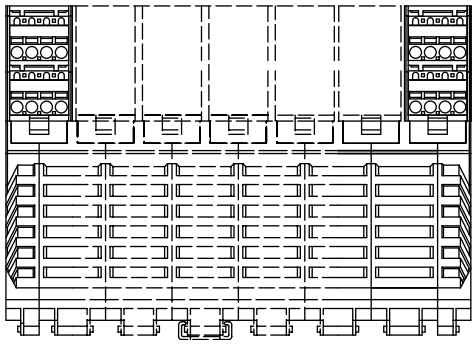
Dimensional Drawings

■ Model F3SX

Model	Width(mm)
EM1	45
E-M1M1, M1D1, L2M1	67.5
E-M1R, N-M1R	90







(Unit : mm)

- The number of slots indicates the width occupied by each module.
  - Main module (N, E) : 1 slot
  - Input module (L2, M1, D1) : 1 slot
  - Relay output module (R, R1, R2) : 2 slots

MEMO

Chapter 2
Specifications of Main Module

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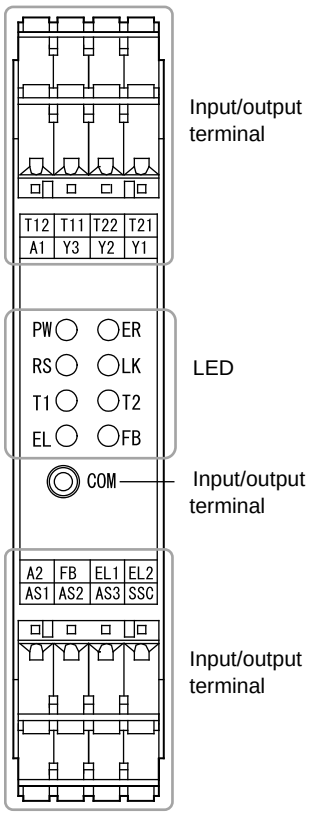
Main Module with External Indicator Output

This module (N module) is the main module with external indicator output.

Each name and functions



■ LED indicator

Indi-cation	Color	Name	Functions
PW	Green	Power indicator	Lights up while power is ON.
ER	Red	Error indicator	Lights up or flashes when an error occurs. Lighting up : No synchronization between emergency-stop inputs. 1-time flashing : Short-circuiting or mis-wiring between emergency-stop inputs. 2-time flashing : Trouble or mis-wiring around emergency-stop input circuit. 3-time flashing : Mis-wiring or break around Y1, Y2 or Y3 terminal. 4-time flashing : Trouble in external indicator or around the circuit for indicator output. 5-time flashing : Trouble or welding around safety relay output circuit. 6-time flashing : Error in feedback signals from an external devices. Continuously flashing : Affected by noises or trouble around the internal circuit of F3SX.
RS	Green	Reset input indicator	Lights up at the time of: · Auto resetting : Y3 terminal input is ON. · Manual resetting : Y2 terminal input is ON.
LK	Yellow	Interlock indicator	Lights up in interlock states.
T1	Green	T12 input indicator	Lights up when input is ON at T12 terminal.
T2	Green	T22 input indicator	Lights up when input is ON at T22 terminal.
EL	Green	External indicator output ON indicator	Lights up when external indicator output is ON. If you use the function set-up software for model F3SX (Model F3SX-CD□□□, sold separately) to set the parameter to enable the blinking function of the external indicator lamp, the indicator lamp will either stay illuminated or blink according to its output operation.
FB	Green	Feedback input indicator	Lights up when feedback input terminal is ON.

■ Input/output terminal

	Terminal No.	Functions
Power input	A1	24V DC input
	A2	GND (0V) input
Emergency-stop input (Note 1)	T11	Emergency-stop switch input
	T12	
	T21	Emergency-stop switch input
	T22	
Reset input	Y1	Reset input, selection between auto reset / manual reset, system reset
	Y2	
	Y3	
Feedback input (Note 2)	FB	Monitoring feedback time
Auxiliary solid-state output (Note 3)	AS1	Instant breaking auxiliary output (Standard Setup:Outputs the signals indicating whether the state is safe or not.)
	AS2	Information trigger (Standard Setup:Turns ON when error data, excessive frequency data of output switching and excessive energizing time data are available)
	AS3	Standby output (Standard Setup:When F3SX CPU has been initialized and the input and output have turned into normally controllable state, the output is turning ON)
Auxiliary input (Note 4)	SSC	Start command input
External indicator output (Note 5)	EL1	Indicator output with diagnosis function (+ : source)
	EL2	Indicator output with diagnosis function (- : sink)
RS-232C port	COM	Port for communication cable connection (RS-232C)

(Note 1) In the case that the emergency-stop switch is not used, directly connect T11 terminal with T12 terminal, and the T21 terminal with the T22 terminal, respectively.

(Note 2) In the case that the feedback input is not used, refer to "Feedback input (FB terminal)".

Feedback input (FB terminal) p.2-12

(Note 3) By using the function set-up software for model F3SX (Model F3SX-CD□□□, sold separately), the function settings of auxiliary solid-state output (at the AS1, AS2 and AS3 terminals) and external indicator output can be changed. For the details, confirm with HELP of Model F3SX-CD□□□.

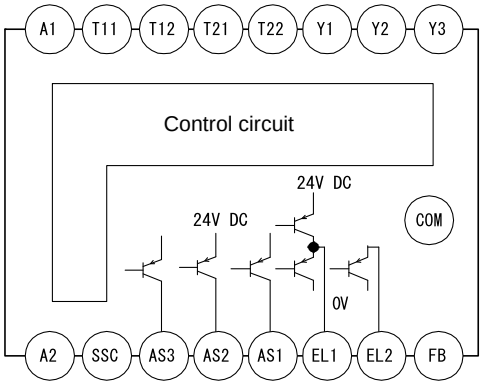
(Note 4) In the case that the start command input is not used, connect SSC terminal with the 24V DC input terminal (A1 terminal) directly.

(Note 5) In the case that the external indicator is not used, connect a resistor (1/4W, 4.7kΩ) between the EL1 terminal and the EL2 terminal.

⚠WARNING

The auxiliary solid-state output (at the AS1, AS2 and AS3 terminals) is not a safety output. Do not use it for the purpose of configuring a safety related system.
Doing so may cause serious injury to humans when a trouble occurs with F3SX or the peripheral devices.

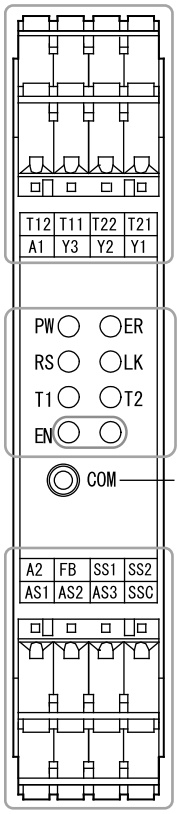
Internal schematic diagram



Main Module with DC solid-state Safety Output

This module (E module) is the main module with DC solid-state safety output.

Each name and functions



Input/output terminal

LED

Input/output terminal

Input/output terminal

■ LED indicator

Indi-cation	Color	Name	Functions
PW	Green	Power indicator	Lights up while power is ON.
ER	Red	Error indicator	Lights up or flashes when an error occurs. Lighting up: No synchronization between emergency-stop inputs. 1-time flashing: Short-circuiting or mis-wiring between emergency-stop inputs. 2-time flashing: Trouble or mis-wiring around emergency-stop input circuit. 3-time flashing: Mis-wiring or break around Y1, Y2 or Y3 terminal. 4-time flashing: Short-circuiting or mis-wiring around the DC solid-state safety out puts. Trouble in the DC solid-state safety output circuits. 5-time flashing: Trouble or welding around safety relay output circuit. 6-time flashing: Error in feedback signals from an external devices. Continuously flashing: Affected by noises or trouble around the internal circuit of F3SX.
RS	Green	Reset input indicator	Lights up at the time of: · Auto resetting : Y3 terminal input is ON. · Manual resetting: Y2 terminal input is ON.
LK	Yellow	Interlock indicator	Lights up in interlock states.
T1	Green	T12 input indicator	Lights up when input is ON at T12 terminal.
T2	Green	T22 input indicator	Lights up when input is ON at T22 terminal.

Indi-cation	Color	Name	Functions
EN	Green	DC solid-state safety output ON indicator	Lights up when DC solid-state safety output is ON.
	Red	DC solid-state safety output OFF indicator	Lights up when DC solid-state safety output is OFF.

■ Input/output terminal

	Terminal No.	Functions
Power input	A1	24V DC input
	A2	GND (0V) input
Emergency-stop input (Note 1)	T11	Emergency-stop switch input
	T12	
	T21	Emergency-stop switch input
	T22	
Reset input	Y1	Reset input, selection between auto reset / manual reset, system reset
	Y2	
	Y3	
Feedback input (Note 2)	FB	Monitoring feedback time
Auxiliary solid-state output (Note 3)	AS1	Safety output monitor (Standard Setup:Outputs signal that is synchronous and in the same logics as those of the safety output)
	AS2	Ready output (Standard Setup:When F3SX CPU has been initialized and the input and output have turned into normally controllable state, the output is turning ON.)
	AS3	Standby output (Standard Setup:When F3SX CPU has been initialized and the input and output have turned into normally controllable state,the output is turning ON)
Auxiliary input (Note 4)	SSC	Start command input
DC solid-state safety output	SS1	DC solid-state safety output 1
	SS2	DC solid-state safety output 2
RS-232C port	COM	Port for communication cable connection (RS-232C)

(Note 1) In the case that the emergency-stop switch is not used, directly connect T11 terminal with T12 terminal, and the T21 terminal with the T22 terminal, respectively.

(Note 2) In the case that the feedback input is not used, refer to “Feedback input (FB terminal)”.

Feedback input (FB terminal) p.2-12

(Note 3) By using the function set-up software for model F3SX (Model F3SX-CD□□□, sold separately), the function settings of auxiliary solid-state output (at the AS1, AS2 and AS3 terminals) can be changed. For the details, confirm with HELP of Model F3SX-CD□□□.

(Note 4) In the case that the start command input is not used, connect SSC terminal with the 24V DC input terminal (A1 terminal) directly.

⚠WARNING

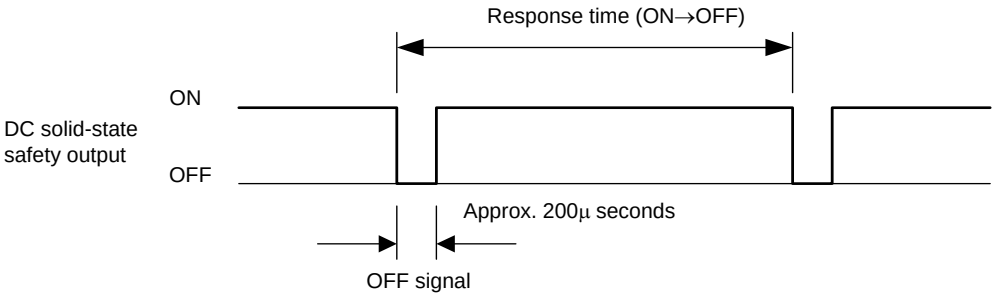
The auxiliary solid-state output (at the AS1, AS2 and AS3 terminals) is not a safety output. Do not use it for the purpose of configuring a safety related system.
Doing so may cause serious injury to humans when a trouble occurs with F3SX or the peripheral devices.

DC solid-state safety outputs (SS1 and SS2 terminals)

■ Waveform of DC solid-state safety output

In order for F3SX to confirm that the output holds its shutoff function, it turns the outputs OFF cyclically for a short time period. When the output signal turns OFF at this time, the output circuits is judged to be normal. However, if it does not turn OFF, the output circuit or the wiring is judged to be abnormal and the controller becomes in the lock-out state.

Watch the input response time of the devices connected to the SS1 and SS2 terminal to be sure that an erroneous operation does not occur with the connecting devices due to OFF pulse signals.



CHECK!

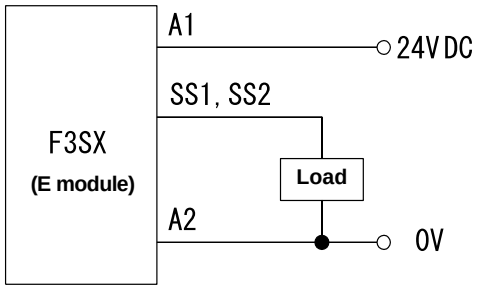
•The response time differs depending on the type.

Rated current, response time, mass, external dimension p.1-7

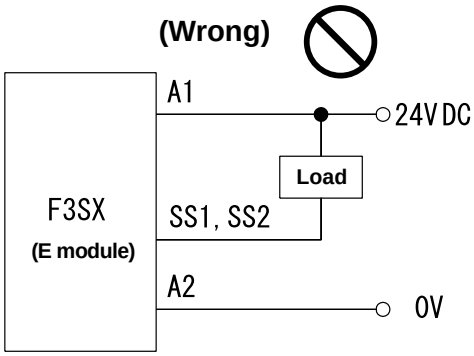
⚠WARNING

DC solid-state safety output;
Connect a load across the output terminal and the 0V line (PNP output). If it is connected between the output terminal and the 24V DC line by mistake, the output may turn reversed when an emergency-stop occurs and cause a dangerous situation.

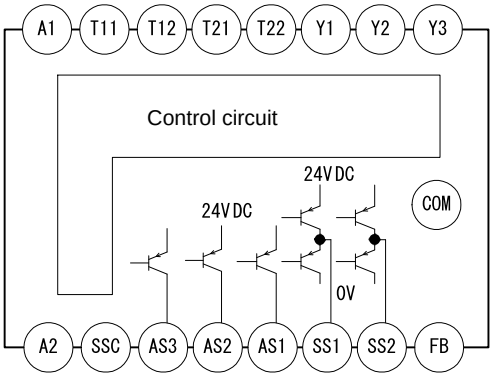
(Correct)



(Wrong)



Internal schematic diagram



Functions of Main Module

Diagnosing and monitoring functions

F3SX diagnoses or monitors the input devices and the external indicator, etc., as to whether an error occurs or not with any of those devices.

▪ Cross channel synchronization monitoring function

It monitors the input channels (Ch 1 - Ch 2) to find any differences in rising time between the input signals through those channels to the effect that any nullification of the safety related system function is prevented.

CHECK!

- The threshold value of the cross channel synchronization monitoring is set to 500ms at the factory shipment.
- By using the function set-up software for F3SX (Model F3SX-CD□□□, sold separately), the threshold value can be changed within the range from 100ms to 1000ms.
  For the details, confirm with HELP of Model F3SX-CD□□□.

▪ Cross channel short-circuiting detection function

It will detect short-circuiting which may occur between the input channels (Ch 1 - Ch 2) and find a disorder of the safety related system. If short-circuiting should occur, it puts F3SX into the lock-out to secure the OFF state. (No fuse replacing is required.)

The following table shows the diagnosing or monitoring contents as well as the erroneous states.

Diagnosis	When an abnormal state is detected:
Cross-channel short-circuiting	Becomes in lock-out state, and outputs an error signal on error indicator. After the power is re-turned ON or the system reset is made, and then the state has returned to normal, the error is released.
Feedback time monitoring	
Error in internal circuit	
Error in external devices	
Error in indicator (short-circuiting or wire break)	Becomes in lock-out state, and outputs an error signal on error indicator. After system reset is made and the state has returned to normal, the error is released.
Cross-channel synchronous monitoring	If the difference of cross-channel timing exceeds the regulated range, safety output turns OFF and outputs an error signal on error indicator. The error will be released when the inputs are returned to OFF for the both channels.

CHECK!

- When F3SX detects an error, the error indicator (ER) lights up or flashes to indicate details of the error.

  Error indications and measures to be taken p.6-27

External indicator outputs (EL1 and EL2 terminals; N module)

An external indicator can be connected.
With the diagnosis functions built in, short-circuiting or wire break of the connected external indicator can be detected. When abnormality of the external indicator is detected, the lock-out will be activated.
The indicator operates as follows depending on the F3SX states.

State of F3SX	Indicator
At safety output ON	Lighting up
At safety output OFF	Lighting out
Interlock state (Note 1)	Lighting out
In lock-out state	Lighting out

(Note 1) The interlock state is that the input devices are ON (safety states) and in the standby state in the manual reset mode.

▪ Wire break detection

The diagnosis begins at the time when the external indicator turns in the lighting up state.
When detecting a wire break, F3SX becomes in a lock-out state.
The external indicator has been set at the factory shipment so that it may light up when the safety output is ON.

CHECK!

•When not used, insert a resistor (1/4W, 4.7kΩ) between EL1 and EL2 terminals.
Model F3SX-N-M1R (Manual reset) p.2-38

•By using the function set-up software for model F3SX (Model F3SX-CD□□□, sold separately), the lighting operations of external indicators can be changed.

NON delay (instant breaking) . . . . . Lighting operation pattern can be chosen (lighting up for ON / lighting out for OFF, or lighting out for ON / lighting up for OFF)
Delay set . . . . . Lighting up or lighting out in synchronous timing with output states of the module which is set for delay.
Flashing for stand-by, lighting up for Ready . . . Flashing : When the main body is in the normal operation and safety input of the main module is ON.
Lighting up: When all the safety inputs are ON.

For the details, confirm with HELP of Model F3SX-CD□□□.

⚠WARNING

The external indicator output is not a safety output. Do not use it for the purpose other than indication.

⚠CAUTION

For the external indicator, use a filament-type lamp for the externally connected indicator. With an LED-type indicator, the perfect detection of a trouble is not available.

DC solid-state safety outputs (SS1 and SS2 terminals; E module)

They are the safety outputs provided by solid-state element circuits.
The short-circuiting in DC solid-state safety output can be detected by the diagnosing functions.

CHECK!

• By using the function set-up software for F3SX (Model F3SX-CD□□□, sold separately), ON-delay or OFF-delay can be set for the DC solid-state safety outputs within the setting range from 0 to 600 seconds (10 minutes).
For the details, confirm with HELP of Model F3SX-CD□□□.

Reset mode

■ Auto reset mode and manual reset mode

The auto reset mode or manual reset mode is set by wiring around the Y1, Y2 and Y3 terminals.

- Connect the NC-type switch for the auto reset mode.
- Connect the NO-type switch for the manual reset mode.

Wiring for reset inputs p.2-28

▪ Auto reset

The safety output turns ON automatically when its conditions are satisfied for turning the safety output ON.
(When ON-delay is set, the safety output turns ON after the ON-delay time elapsed.)

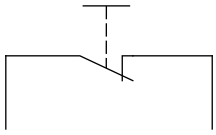
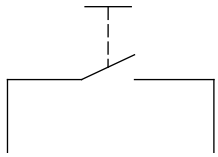
▪ Manual reset

Even the conditions are satisfied for turning the safety output ON, the interlock state prevails and the safety output does not turn ON.
In order to turn the safety output ON, it is necessary to execute the manual reset (interlock reset).
(When ON-delay is set, the safety output turns ON after the manual reset is executed and the ON-delay time elapsed.)

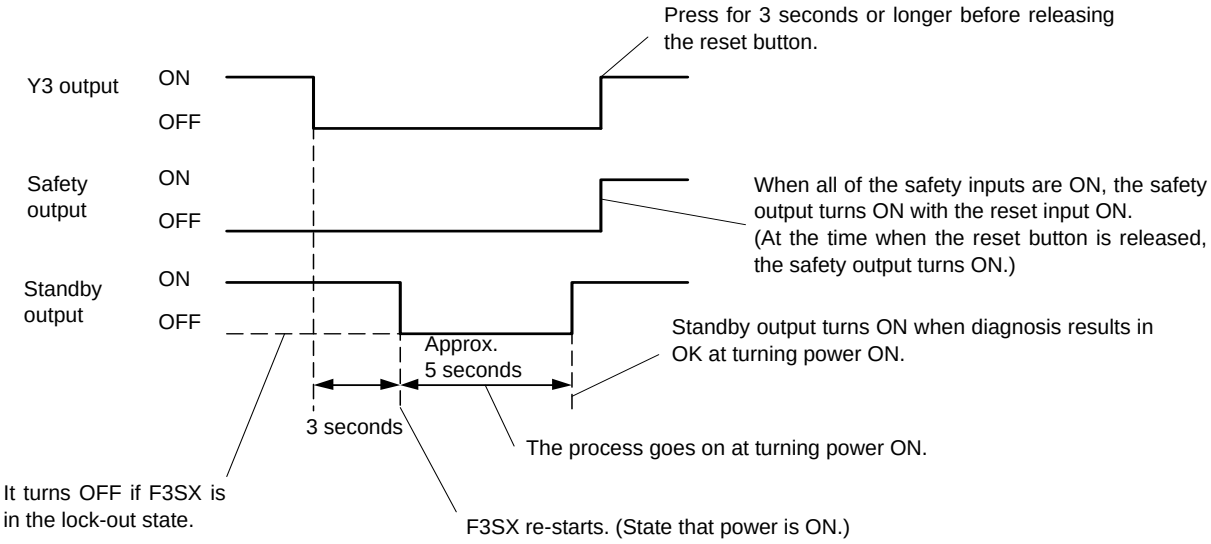
CHECK!

- "Interlock state" is the state awaiting a reset input while the input device is ON (safe state) in the manual reset mode.
- As it gets in the interlock state, the interlock indicator (LK) of the main module lights up.

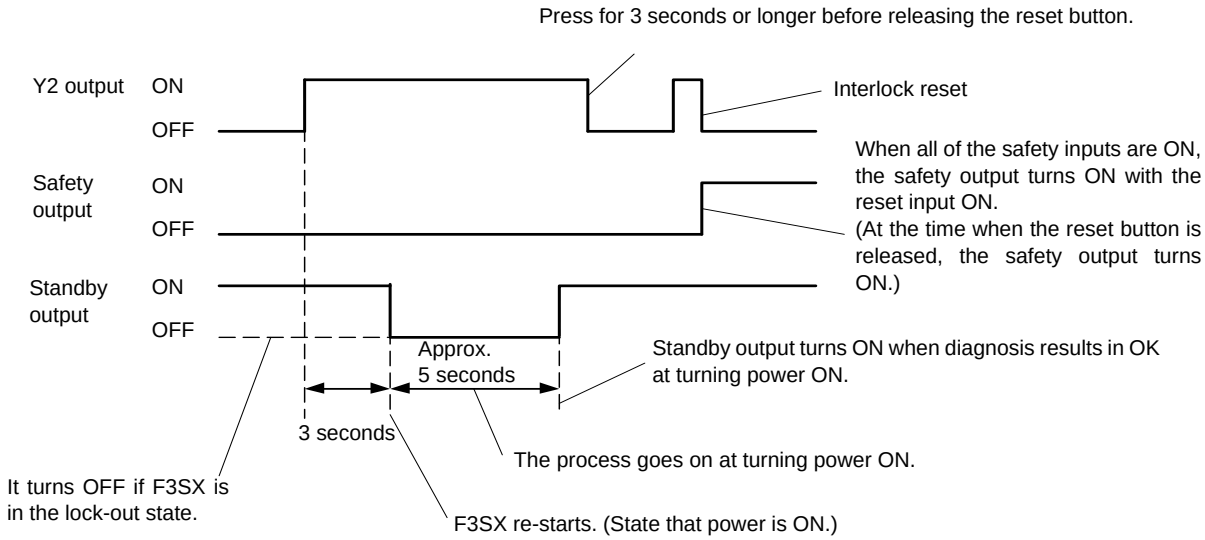
- The reset contents and conditions differ depending whether it is auto reset mode or manual reset mode.

Reset mode	State of F3SX	Time duration of reset input (while reset switch is pressed)	
		50ms ≤ input time < 3s	3s ≤ input time
Auto reset 	Safety output OFF state	-	System reset
	Safety output ON state	-	-
	At lock-out	-	System reset
Manual reset 	Safety output OFF state (At the interlock state)	Reset of interlock	System reset
	Safety output ON state	-	-
	At lock-out	-	System reset

▪ At the time of auto reset


Press for 3 seconds or longer before releasing the reset button.
Y3 output
ON
OFF
Safety output
ON
OFF
When all of the safety inputs are ON, the safety output turns ON with the reset input ON.
(At the time when the reset button is released, the safety output turns ON.)
Standby output
ON
OFF
Approx. 5 seconds
Standby output turns ON when diagnosis results in OK at turning power ON.
3 seconds
The process goes on at turning power ON.
It turns OFF if F3SX is in the lock-out state.
F3SX re-starts. (State that power is ON.)

▪ At the time of manual reset


Press for 3 seconds or longer before releasing the reset button.
Y2 output
ON
OFF
Interlock reset
Safety output
ON
OFF
When all of the safety inputs are ON, the safety output turns ON with the reset input ON.
(At the time when the reset button is released, the safety output turns ON.)
Standby output
ON
OFF
Approx. 5 seconds
Standby output turns ON when diagnosis results in OK at turning power ON.
3 seconds
The process goes on at turning power ON.
It turns OFF if F3SX is in the lock-out state.
F3SX re-starts. (State that power is ON.)

■ System reset

The system reset is executed by pressing down the reset switch for three seconds or longer. The system reset makes the power turned OFF and ON again.

When the safety output is ON, the system reset is not acceptable during the execution in which the power is being turned ON again.

CHECK!

- While the system reset is executed, all the indicators turn OFF except for the power indicator (PW).
- The reset state can be confirmed with the Standby output.

Feedback input (FB terminal)

It is the function to monitor the external device states.
It inputs the monitoring signal received from the external devices (such as NC contact of a relay) to the feedback input terminal to check if the signal synchronizes in reverse with the F3SX safety output.
If the monitoring signal is not input by the feedback time monitoring functions within the monitoring time period, F3SX is determined to be in the feedback error state and put into the lock-out state.

■ Examples of uses

- Mal-functioning such as welding can be detected by inputting contactor's NC contact signal as the feedback signal to F3SX.
- Stop operation can be confirmed on the external device such as a motor which does not come into stop state instantly due to its inertia at the moment that the power turns OFF.
  (Only when the feedback signal input is given to detect the stop operation)
- Monitoring output time of feedback signal can forecast worn brake, etc., of the external device.
- The history of feedback signals can be used for trend control of time before stop (= verification on the reasonable safety distance).

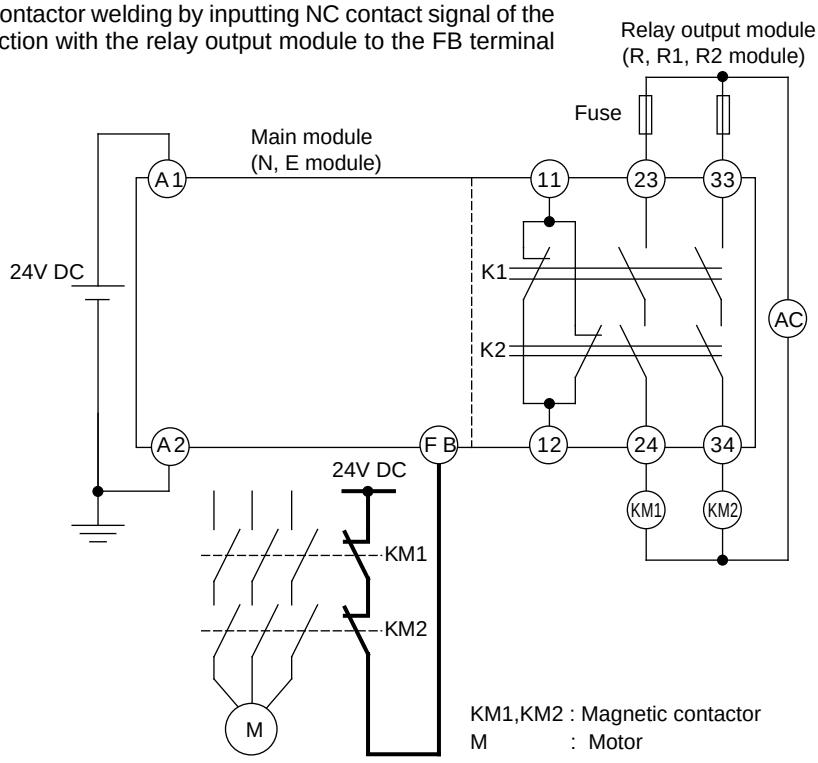
CHECK!

•The monitoring process for output time of feedback signal begins automatically at the time when power is turned ON. Sixteen historical measurements in feedback monitoring time are retained but will be cleared at the time when power is turned OFF or the system is reset. If you want to save the history, read and save it on the host computer or other means.

Communication Reference p.6-5

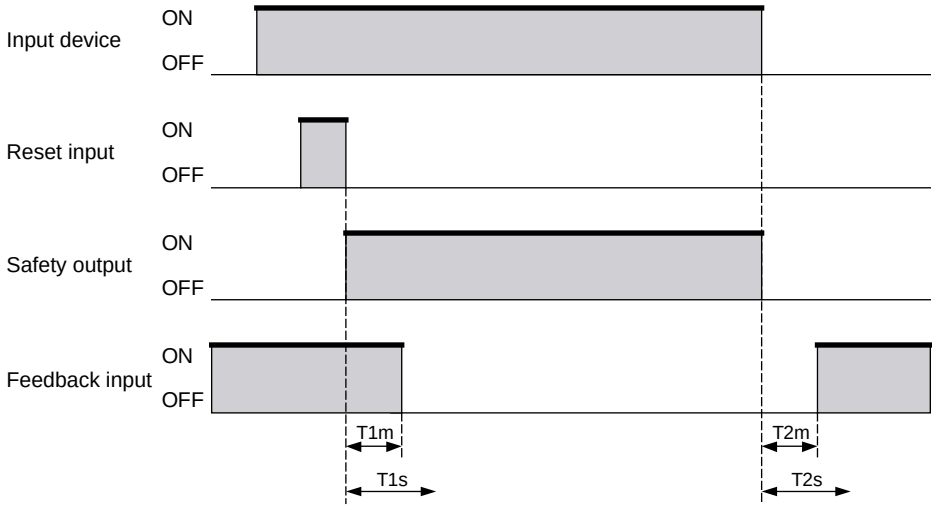
■ Wiring example of feedback input

In the case of detecting contactor welding by inputting NC contact signal of the external device in connection with the relay output module to the FB terminal for the feedback signal.



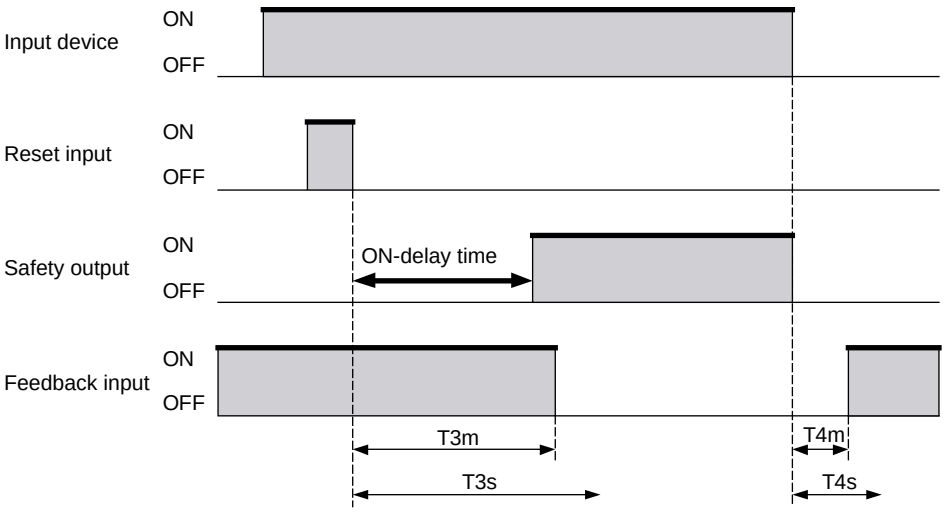
■ Operation chart of feedback input

- **In the case that delay time is not set (manual reset mode)**
  (Example of uses: Inputting NC contact signal of the external device in connection with the R module to the FB terminal for the feedback signal.) Model F3SX-N-M1R (Manual reset) p.2-38



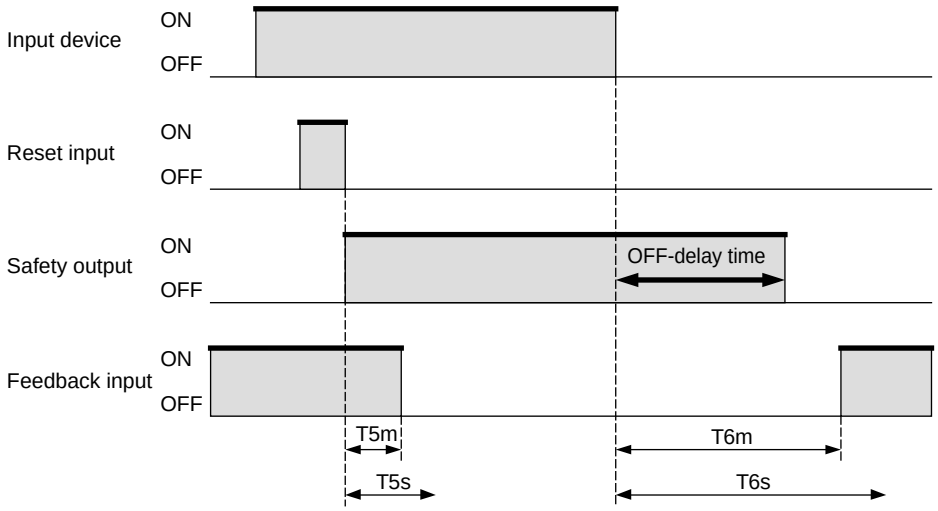
Safety output when changing from OFF to ON	T1m: Feedback time T1s: Monitoring time threshold value	Locking out when T1m > T1s
Safety output when changing from ON to OFF	T2m: Feedback time T2s: Monitoring time threshold value	Locking out when T2m > T2s

- **In the case that ON-delay time is set (manual reset mode)**
  (Example of uses: Inputting NC contact signal of the external device in connection with the R1 module to the FB terminal for the feedback signal.)



Safety output when changing from OFF to ON	T3m: Feedback time T3s: Monitoring time threshold value	Locking out when T3m > T3s
Safety output when changing from ON to OFF	T4m: Feedback time T4s: Monitoring time threshold value	Locking out when T4m > T4s

- **In the case that OFF-delay time is set (manual reset mode)**
  (Example of uses: Inputting NC contact signal of the external device in connection with the R2 module to the FB terminal for the feedback signal.)



Safety output when changing from OFF to ON	T5m: Feedback time T5s: Monitoring time threshold value	Locking out when T5m > T5s
Safety output when changing from ON to OFF	T6m: Feedback time T6s: Monitoring time threshold value	Locking out when T6m > T6s

CHECK!

- Input the signal, which satisfies the feedback input operation time chart, for the feedback signal.
- The threshold value of feedback monitoring time is set to 500ms at the factory shipment. By using the function set-up software for model F3SX (Model F3SX-CD □□□, sold separately), the monitoring time can be changed. For the details, confirm with HELP of Model F3SX-CD □□□.
- The threshold value of feedback monitoring time for the -T□□□ type is set to 500ms at the factory shipment, and cannot be changed by using the function set-up software for model F3SX (Model F3SX-CD □□□, sold separately).

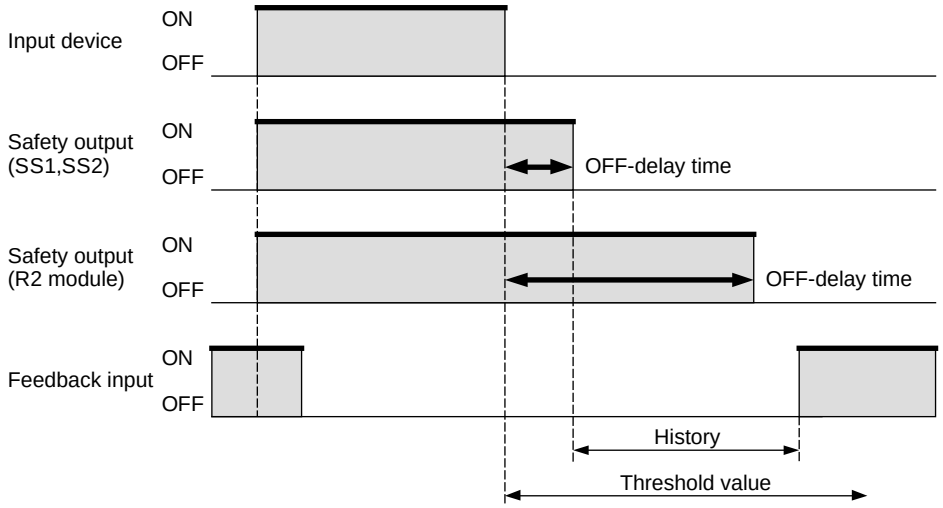
■ Operation chart of feedback input when OFF-delay time is set for DC solid-state safety output

ON-delay time or OFF-delay time setting is enabled for the DC solid-state safety outputs (SS1 and SS2 terminals) of the E module by using the function set-up software for F3SX (Model F3SX-CD□□□, sold separately).
When delay time is set for the DC solid-state safety outputs in the F3SX-E-□□□R1 or F3SX-E-□□□R2 configuration, the history read out by the function set-up software for F3SX will be as follows depending on the set time length and feedback input route. (The product is set to "non-delay" at the factory shipment.)

▪ In the case of inputting monitoring signal received from external device in connection with FB terminal to R1 (R2) module

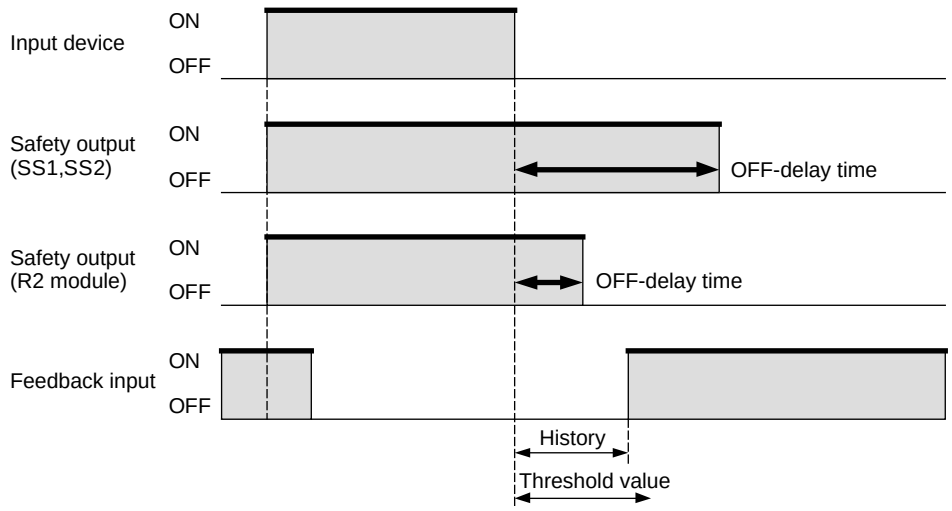
- When the DC solid-state safety output is activated earlier than the R1 (R2) module, the feedback history will show the time from when the DC solid-state safety output was activated until the monitoring signal is input to the FB terminal.

•Example: OFF-delay time of DC solid-state safety output < R2 module OFF-delay time



- When the DC solid-state safety output is activated later than the R1 (R2) module, the feedback history will show the time from when the R1 (R2) module was activated until the monitoring signal is input to the FB terminal.

•Example: OFF-delay time of DC solid-state safety output > R2 module OFF-delay time

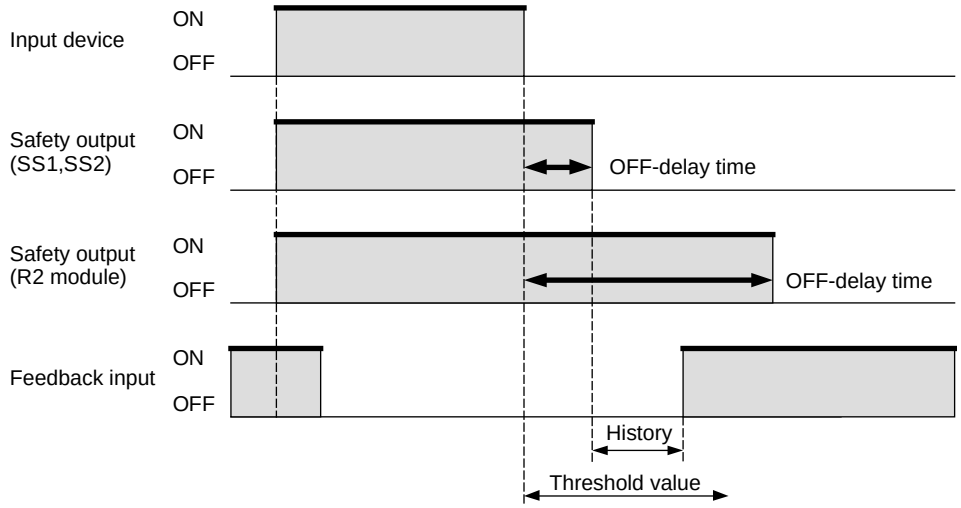


- In the case of inputting monitoring signal received from external device in connection with the DC solid-state safety output to the FB terminal

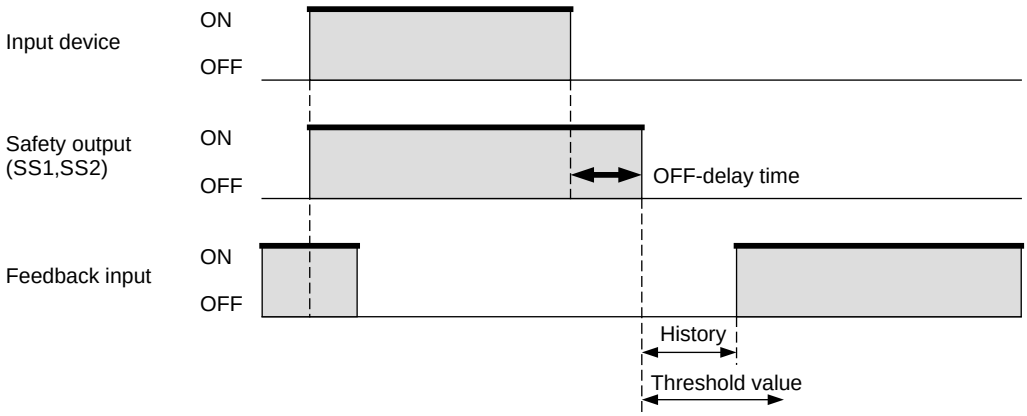
Model F3SX-EM1 (Manual reset) p.2-30

- The feedback history will show the time from when the DC solid-state safety output is activated until the monitoring signal is input to the FB terminal.

•Example: OFF-delay time of DC solid-state safety output < R2 module OFF-delay time

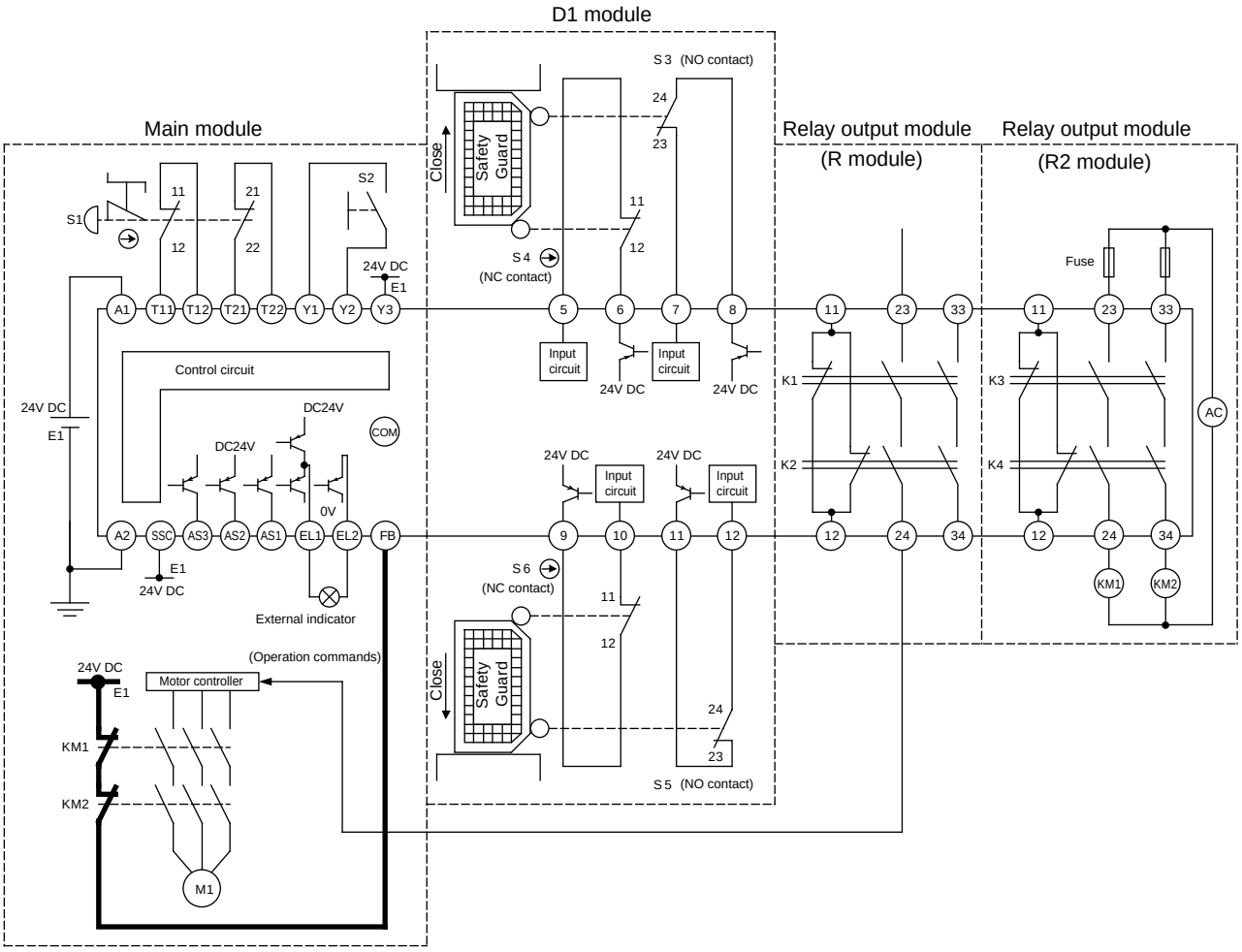


- **Example: The type which is not equipped with a relay output module (F3SX-E-□□□□). OFF-delay time should be set to the DC solid-state safety output.**



■ Example of changing feedback monitoring threshold value

F3SX-N-D1RR2 (In case the OFF-delay time is set to 3 seconds.) (Model No. for reference)



S1 : Emergency-stop switch (positive opening mechanism) (Model A165E, Model A22E) ⊖
S2 : Reset switch
S3, S5 : Limit switch
S4, S6 : Safety limit switch (positive opening mechanism) (Model D4N, Model D4B) ⊖
KM1, KM2: Magnetic contactor
M : 3-phase motor
E1 : 24V DC power source (Model S82K)
External indicator: Filament type indicator (When any external indicator is not used, connect a resistor (1/4W, 4.7kΩ).)

In the case of using NC contacts of the external devices (KM1 and KM2 in the above wiring example) in connection with the R2 module for the feedback signal, it is necessary to change threshold value of the feedback monitoring time (when safety output changes from ON to OFF) after having changed the OFF-delay time.

R2 module response time	40ms	(Refer to the response time table.)
R2 module delay time	3000ms	(Delay time: 3 seconds)
Response time of external device	10ms	(10ms as assumed in this example)
+α(margin)	450ms	(450ms as assumed in this example)
Total (set value)	**3500ms**	

(Note)
Threshold value of the feedback monitoring time is set to 500ms at the factory shipment. Therefore, if only the OFF-delay time is changed without changing the threshold value of the feedback monitoring time, a feedback error occurs with F3SX and will put it in the lock-out state because the monitoring signal is not input from the external device within the monitoring time period.

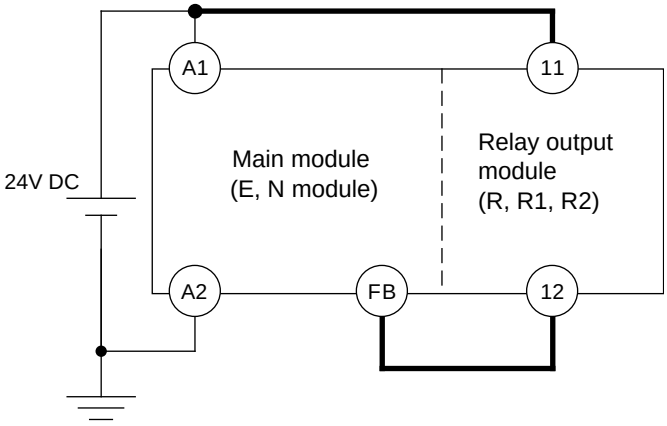
Rated current, response time, mass, external dimension p.1-7

■ Wiring example for not using the feedback monitoring function

Wire as mentioned below when external device states are not monitored. However, contact welding cannot be detected for the contactor.

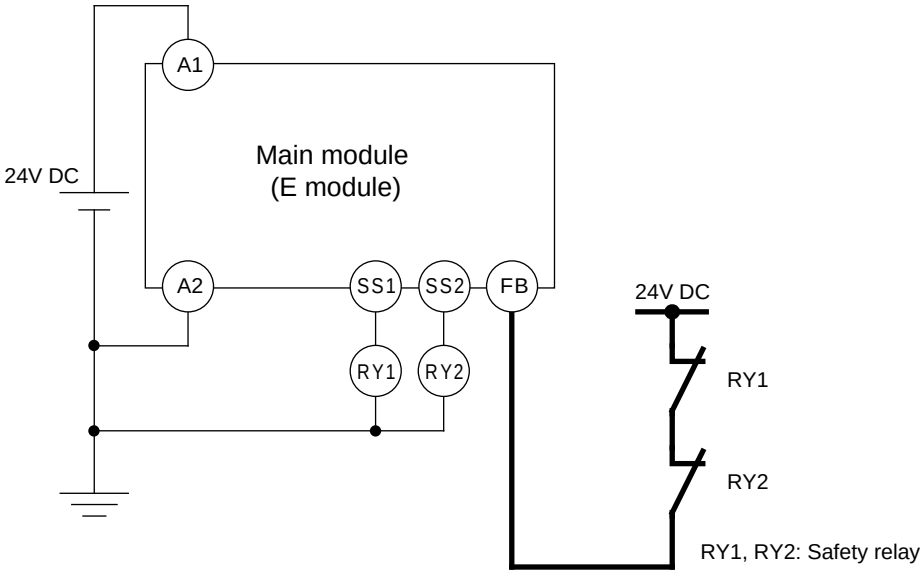
▪ Model equipped with the relay output module;

For not using the feedback monitoring function of a model which is equipped with the relay output module, make wiring according to the Figure below.
With the R1/R2 module, it is necessary to change threshold value of the feedback monitoring time by using the function set-up software for model F3SX (Model F3SX-CD□□□, sold separately) in consideration for the delay time setting value.



▪ Model not equipped with the relay output module;

For not using the feedback monitoring function of a model (Model F3SX-E-□□□□)which is not equipped with the relay output module, make wiring according to the Figure below.
In case of having set a delay time to the DC solid-state safety output by using the function set-up software for model F3SX (Model F3SX-CD□□□, sold separately), it is necessary to change threshold value of the feedback monitoring time in consideration for the delay time setting value.



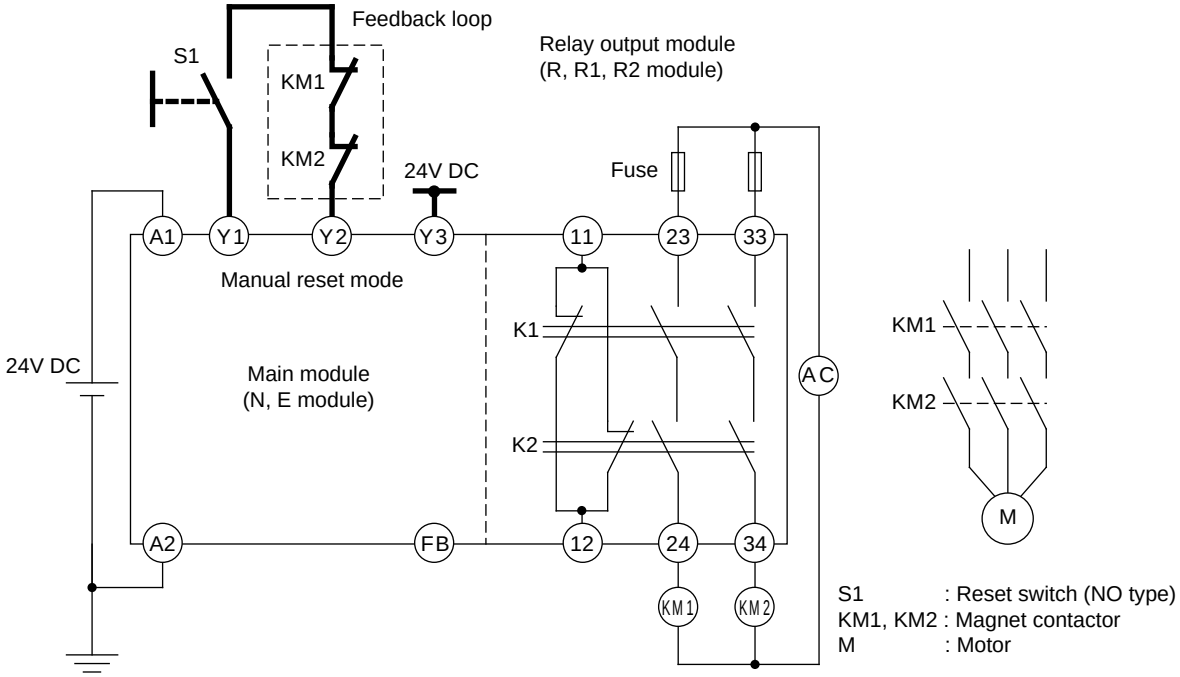
▪ For the case of nullifying the feedback time monitoring function;

The feedback time monitoring function can be nullified by using the function set-up software for model F3SX (Model F3SX-CD□□□, sold separately).When the feedback time monitoring function is nullified, the function does not work at the time when the safety output switches either from OFF to ON or from ON to OFF.
In this case, the "feedback input monitor" of the auxiliary output does not function.

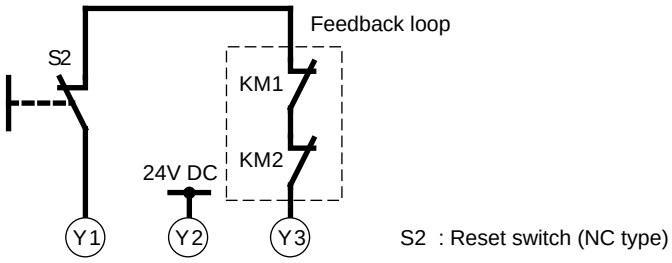
■ Wiring example for the case that the feedback time monitoring function cannot be used;

Although the R1/R2 module delay time is 600sec (10 minutes) at maximum, the feedback time monitoring threshold value, which can be set by using the function set-up software for model F3SX (Model F3SX-CD□□□ sold separately), ranges from 10ms to 59990ms (approximately 1 minute).
Therefore, if the delay time exceeds the threshold time, make the settings and wiring in the following procedures.

1. Nullify the feedback time monitoring function by using the function set-up software for model F3SX .
2. Make wiring referring to the wiring example below. (Model No. for reference)



Wire the auto reset mode as follows.

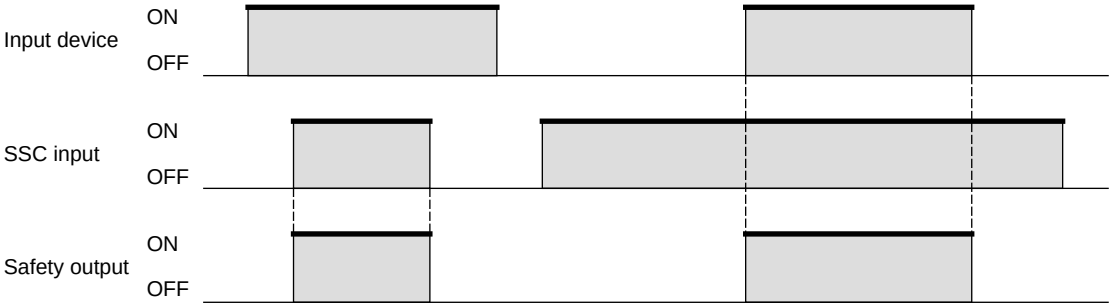


Start command input (SSC terminal)

The start command input (SSC terminal) is a start permission input for those other than safety input.
The safety output does not turn ON unless the SSC input turns ON.
For an example, it can be used for a start command input received from the programmable controller (PLC).

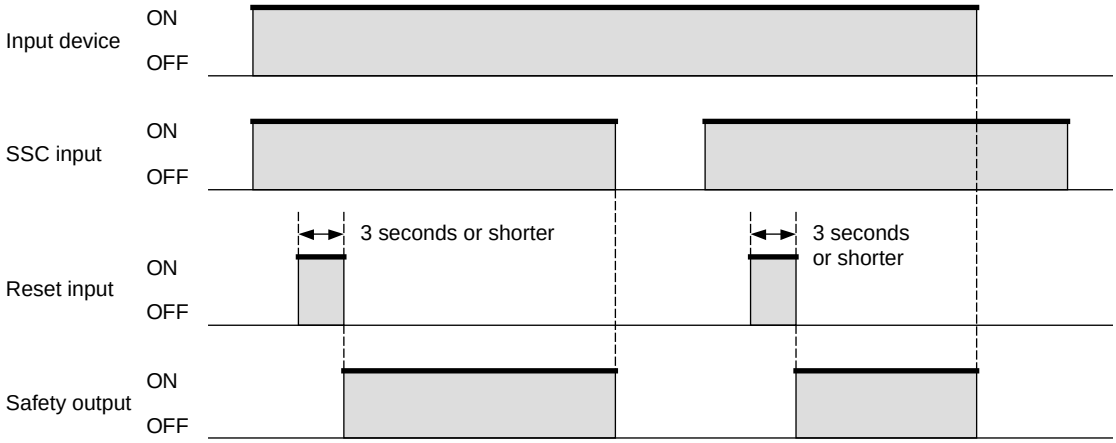
■ Auto reset mode

When the start command input is ON while all the input devices are in the ON states, F3SX safety output turns ON.
As the SSC terminal is made OFF while the safety output is ON, the safety output turns OFF.



■ Manual reset mode

When the start command input is ON while all the input devices are in the ON states, F3SX safety output turns ON after the interlock reset is input.
As the SSC terminal is made OFF while the safety output is ON, the safety output turns OFF.



CHECK!

- External device conditions can be monitored by inputting the standby signal from the AS3 terminal to the SSC terminal through the PLC RUN contact, etc.
- If not used, directly connect SSC terminal with 24V DC input terminal (A1 terminal).

Model F3SX-N-M1R (Manual reset) p.2-38

⚠WARNING

Do not use the auxiliary input terminals (start command input) for connection with a safety input device for the purpose of configuring a safety related system.
Doing so may cause serious injury to humans when a trouble occurs with F3SX or the peripheral devices.

Apply neither of a voltage exceeding the rated nor an AC power supply across the auxiliary input terminals (start command inputs).
Doing either of these may cause breakdown of device and/or danger such as an electric shock.

Auxiliary solid-state outputs (AS1, AS2, AS3 terminals)

By using the auxiliary solid-state outputs, monitoring from the external controller is enabled.
Each of the auxiliary solid-state outputs is allocated to the functions shown in the following table at the time of factory shipment.

Type	AS1 terminal	AS2 terminal	AS3 terminal
N module	Instant breaking auxiliary output (synchronous)	Information trigger	Standby output
E module	Safety output monitor (synchronous)	Ready output	Standby output

- The functions of auxiliary solid-state output terminals can be changed by using the function set-up software for F3SX (Model F3SX-CD□□□, sold separately). For the details, confirm with HELP of Model F3SX-CD□□□.

Type	Functions
Instant breaking auxiliary output	Outputs the signals indicating whether the state is safe or not. The output state can be chosen (synchronous/reverse). Choice is available only for N module. Instant breaking auxiliary output (AS1 terminal; N module) p.2-22
Safety output monitor	Monitors the main module (except N module) and safety output of output module. Choice between monitored module and output states is available (synchronous/reverse). Safety output monitor (AS1 terminal; E module) p.2-22
Information trigger	Output turns ON when the main body is in either of the following states: (1) Lock-out state; (2) Time-out in either cross input channel synchronization monitoring time; (3) Switching frequency of safety output exceeds the alarm value; (4) Accumulated power-on time exceeds predetermined value (approx. 3 years). Information trigger (AS2 terminal ; N module) p.2-23
Ready output	Output is ON when the main body is in the Ready state (all the safety inputs of main module and input module are ON). Ready output (AS2 terminal ; E module) p.2-24
Standby output	Output is ON when safety input of the main module is ON while the main body is in the normally operating state. Standby output (AS3 terminal) p.2-25
Lock-out output	Output is ON when the main body is in the lock-out state.
Output switching frequency alarm	Output is ON when switching frequency of safety output (as counted by the times of turning from ON to OFF) exceeds the alarm value. The alarm value can be set within the range from 1 to 1 million.
Accumulated power-on time alarm	Output is ON when accumulated power-on time exceeds the predetermined value (approx. 3 years). The alarm value cannot be changed.
Feedback input monitor	Output is ON when the feedback input terminal turns ON. It does not function when the feedback time monitoring function is nullified.

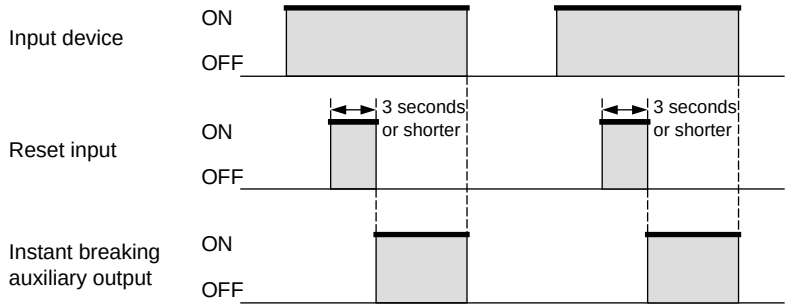
⚠WARNING

The auxiliary solid-state output (at the AS1, AS2 and AS3 terminals) is not a safety output. Do not use it for the purpose of configuring a safety related system.
Doing so may cause serious injury to humans when a trouble occurs with F3SX or the peripheral devices.

■ Instant breaking auxiliary output (AS1 terminal; N module)

It outputs the signal indicating whether the state is safe or not. The output state can be chosen (synchronous/ reverse). Choice is available only for the N module.

- **Operation chart (manual reset mode)**



⚠WARNING

The instant breaking auxiliary output is not a safety output. Do not use it for the purpose of configuring a safety related system.
Doing so may cause serious injury to humans when a trouble occurs with F3SX or the peripheral devices.

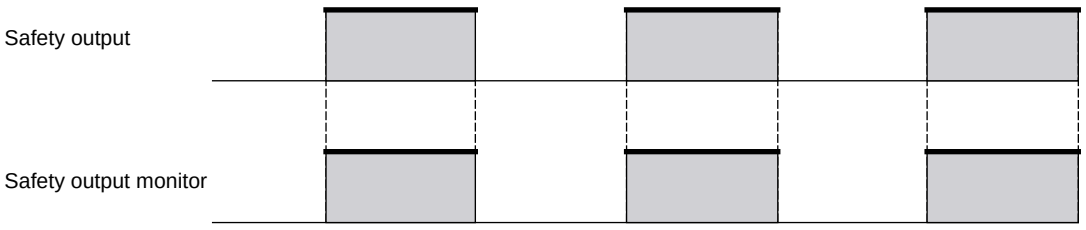
■ Safety output monitor (AS1 terminal; E module)

Monitors the DC solid-state safety output or safety output of the relay output module.

CHECK!

•By using the function set-up software for model F3SX (Model F3SX-CD□□□, sold separately), it can be made synchronous/reverse to the following outputs. For the details, confirm with HELP of Model F3SX-CD□□□.
(1) DC solid-state safety output of E module
(2) R module
(3) R1 module (ON-delay)
(4) R2 module (OFF-delay)

▪ Operation chart



⚠WARNING

Safety output monitor is not the safety output. Do not use it for the purpose of configuring a safety related system.
Doing so may cause serious injury to humans when a trouble occurs with F3SX or the peripheral devices.

■ Information trigger (AS2 terminal ; N module)

The output turns ON when the main body is in either of the following states.
This trigger signal can be used for the command request towards the host side such as the programmable controller (PLC), the personal computer (PC), etc.

Communication Reference p.6-5

Information	Description
Error information	Information to be output when either of the following error occurs: • Lock-out
Excess switching frequency of output	It is the information to be output when the ON/OFF switching frequency of the safety output exceeds the pre-set switching frequency. The frequency can be set to a value within the range from one to one million times.
Excess energizing time	It is the information to be output when the accumulated power-ON time of F3SX exceeds more or less 30,000 hours. The hour value for alarming the accumulated power-ON time cannot be changed.

⚠WARNING

The information trigger is not the safety output. Do not use it for the purpose of configuring a safety related system.
Doing so may cause serious injury to humans when a trouble occurs with F3SX or the peripheral devices.

■ Ready output (AS2 terminal ; E module)

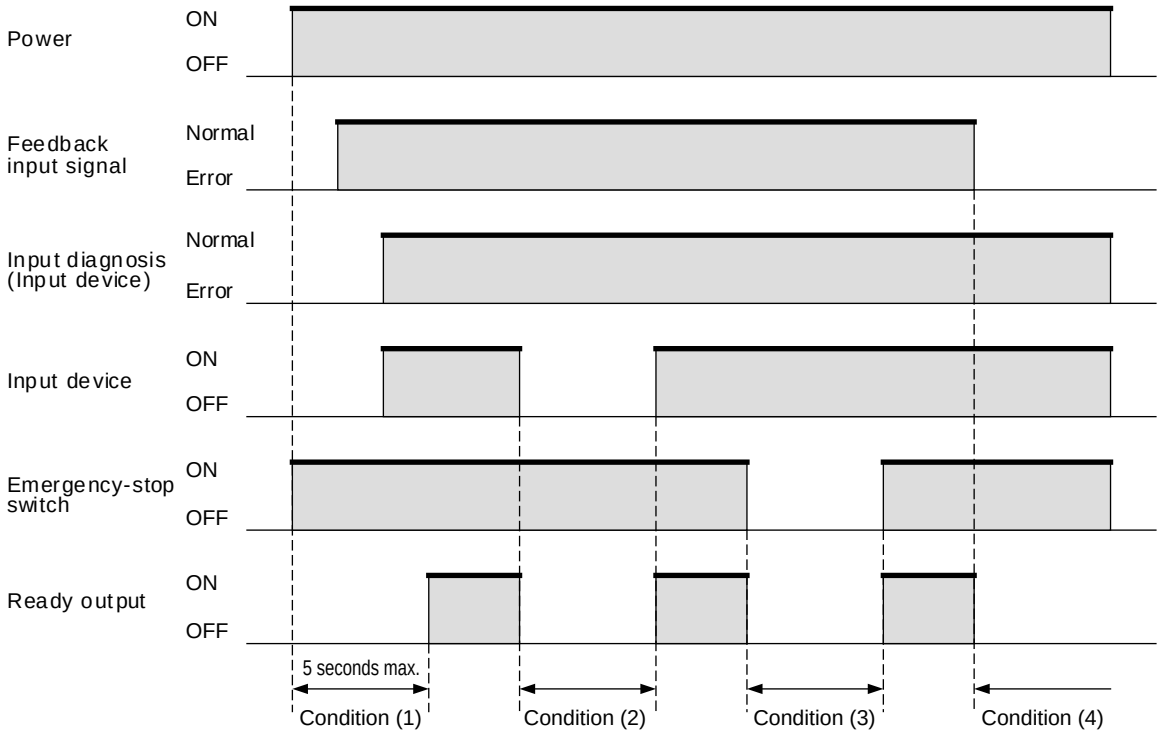
The output turns ON when F3SX CPU has been initialized and the input and output have turned into the normally controllable state.
When F3SX is in either of the following states, the Ready output turns OFF.

State	Ready output
In lock-out state	OFF
Emergency-stop switch connected to the main module is pressed.	OFF
When either of the input devices are OFF.	OFF

⚠WARNING

The Ready output is not the safety output. Do not use it for the purpose of configuring a safety related system.
Doing so may cause serious injury to humans when a trouble occurs with F3SX or the peripheral devices.

▪ Operation chart (The following diagnosis timing is an example.)



Condition (1) : The CPU of F3SX is initialized after the power is turned ON, and if both of the feedback input signal and input diagnosis results are normal, the Ready output turns ON.
Condition (2) : When the input device turns OFF, the Ready output turns OFF.
Condition (3) : When the emergency-stop switch is pressed (OFF state), the Ready output turns OFF.
Condition (4) : When F3SX becomes in the lock-out state, the Ready output becomes OFF.
The above operation chart shows an example in which the lock-out state has been caused by a feedback input signal error. (The lock-out may occur likewise by an input diagnosis error.)

■ Standby output (AS3 terminal)

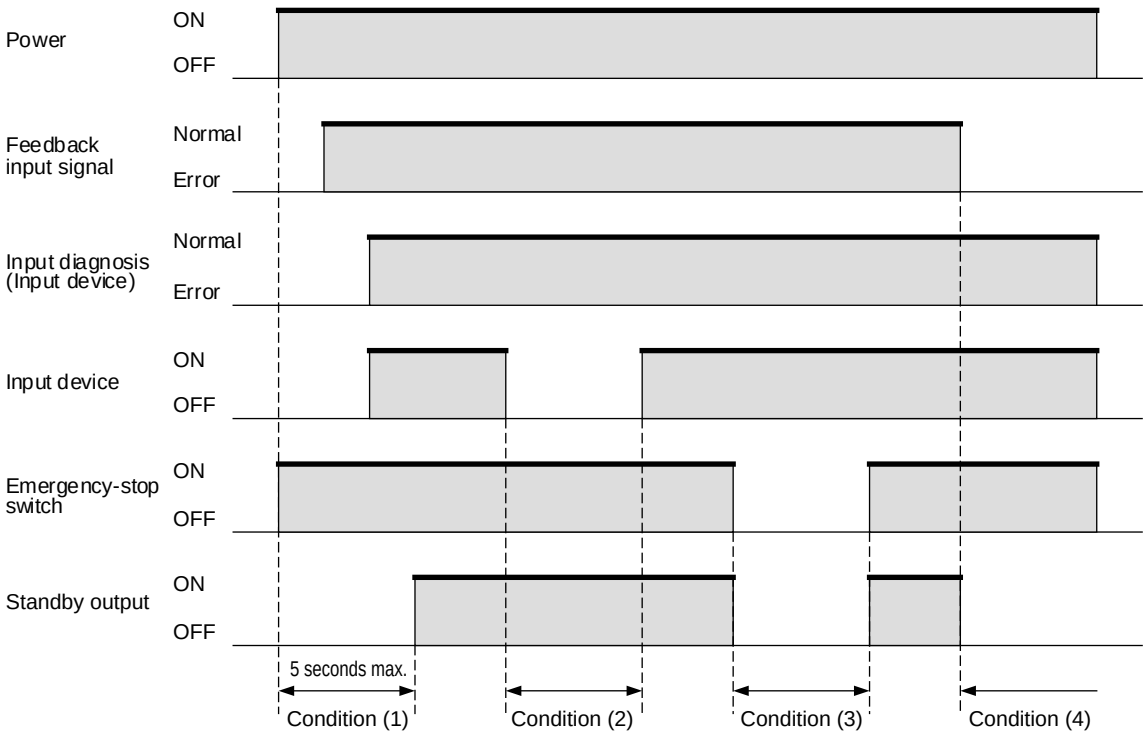
When F3SX CPU has been initialized and the input and output have turned into normally controllable state, the Standby signal is output. It is irrelevant to the ON/OFF state of the input device connected to the input module. It can be used for a part of the preparation signal to the entire system operation.
When F3SX is in either of the following states, Standby output turns OFF.

State	Standby output
In lock-out state	OFF
Emergency-stop switch connected to the main module is pressed.	OFF

⚠WARNING

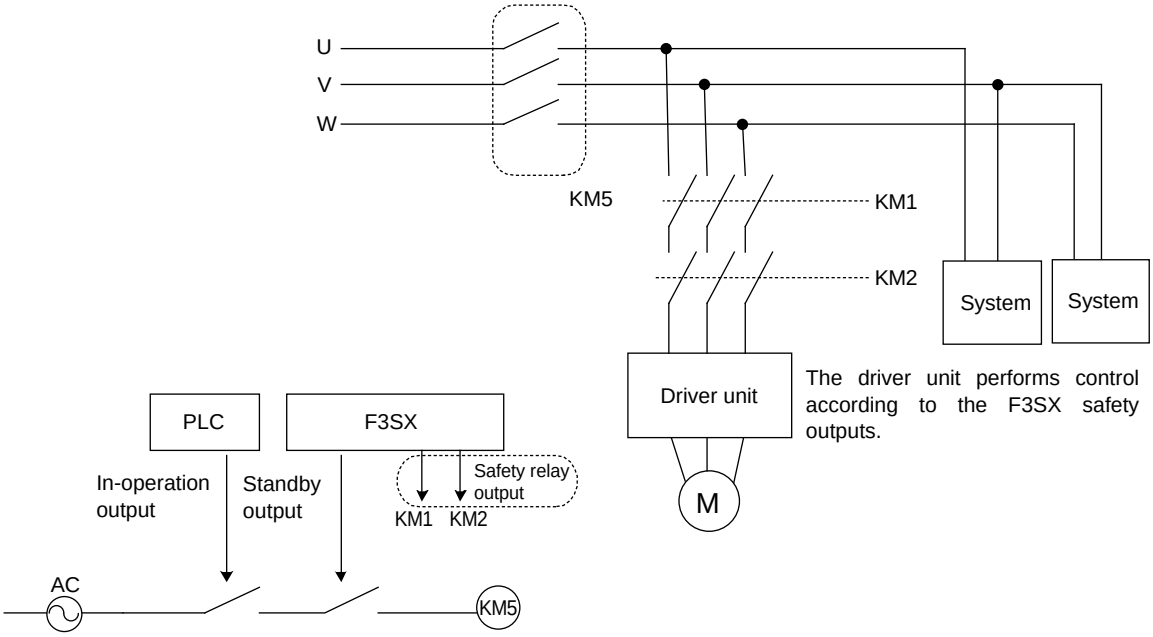
The Standby output is not the safety output. Do not use it for the purpose of configuring a safety related system.
Doing so may cause serious injury to humans when a trouble occurs with F3SX or the peripheral devices.

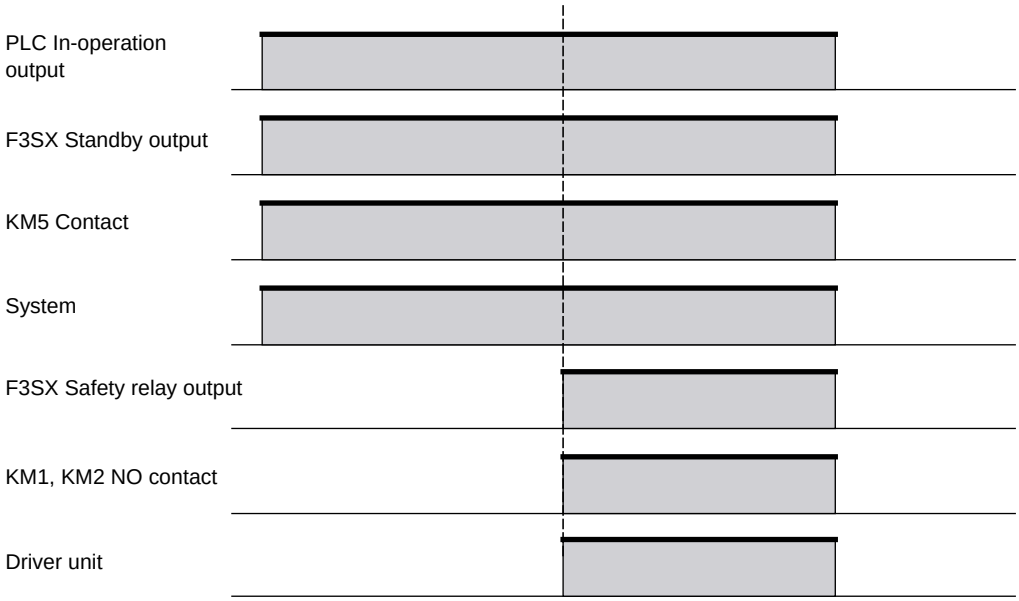
▪ Operation chart (The following diagnosis timing is an example.)



Condition (1) : The CPU of F3SX is initialized after the power is turned ON, and if both of the feedback input signal and input diagnosis results are normal, the Standby output turns ON. (It is irrelevant to ON/OFF of the input devices at this time.)
Condition (2) : The Standby output turns ON irrelevantly to ON/OFF of the input devices.
Condition (3) : When the emergency-stop switch is pressed (OFF state), the Standby output turns OFF.
Condition (4) : When F3SX becomes in the lock-out state, the Standby output becomes OFF.
The above operation chart shows an example in which the lock-out state has been caused by a feedback input signal error. (The lock-out may occur likewise by an input diagnosis error.)

▪ Example of use





Communication functions (COM terminal)

Program can be created on the host side such as on the programmable controller (PLC), personal computer (PC), etc., and the input/output information of the F3SX control signal can be read out.
The followings are the information to be read out:

Communication Reference p.6-5

▪ Status of F3SX

All of the ON/OFF states of the F3SX input and output terminals can be read. When an error occurs, the error massage can be read as to which module is erroneous.

▪ Measured value of feedback monitoring time

- The time duration from when the safety output turns OFF till the feedback input turns ON.
- The time duration from when the safety output turns ON till the feedback input turns OFF.

Each of these can be read out for the measured value of feedback monitoring time. Also, the each measured value as many as 16 times before the latest can be read likewise.

Note) While the power is OFF, it is not stored in F3SX. Save it in the host side where it is necessary.

▪ Accumulated energizing time

The accumulated time length in which F3SX power is ON can be read out.

The value is monitored and stored every 15 minutes.

▪ Switching frequency of output

The accumulated switching times can be read out regarding the safety output of F3SX.

The value is monitored and stored every 15 minutes.

▪ Error code

When F3SX is locked-out, the error code can be read out for the error details.

See the "Troubleshooting" of the manual for the error codes and the correspondences.

Troubleshooting p.6-25

▪ Error log

An error code and the error log can be read out for the accumulated energizing time at the time of occurring the error. The error logs as many as 10 times before the latest can be read.

The error logs are stored in F3SX even when the power is OFF.

▪ Echo back

Echo back is read for testing purposes on the communication functions. The arbitrary data is sent back when it is transmitted from the host side.

▪ Cross-channel synchronous monitoring time

With regard to the emergency-stop input section and the safety input section of the input module of F3SX, the time differences from when one side turns ON until the other turns ON is logged. Each measured value as many as 16 times before the latest can be read out.

Note) While the power is OFF, it is not stored in F3SX. Save it in the host side where it is necessary.

CHECK!

Example of use (1)
The system has been locked-out before recognizing. The time and reason should be known.
→ By reading out the error log,
・at which device an error occurs or improperly wired and
・when had it occurred,
are determined.

CHECK!

Example of use (2)
It should be known how long the safety relay of F3SX might remain normally operable.
→The accumulated relay switching frequencies are known when the output switching frequencies are read out.
On the basis of this frequency, the residual allowance in the life duration can be estimated.

CHECK!

- When communication cable is always connected, fix the cable with a clamp, so as to make it unstressed and prevent from dropout.

⚠WARNING

Do not use the F3SX's communication functions with a host computer for the purpose of configuring a safety related system.
Doing so may cause serious danger if any trouble occurs with the wiring or programming of the host computer.

Connection

⚠WARNING

Wiring must be done while the power is turned OFF either for F3SX or the devices connected with it.
Doing it with the power ON may cause an electric shock, and external devices in connection with this product may behave in an unexpected way.

Ensure that the connections are made properly at the input and output terminals.
Failure to ensure this may cause an electric shock or damage the safety functions.

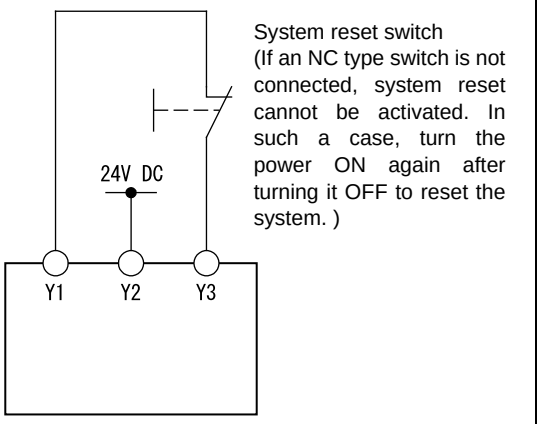
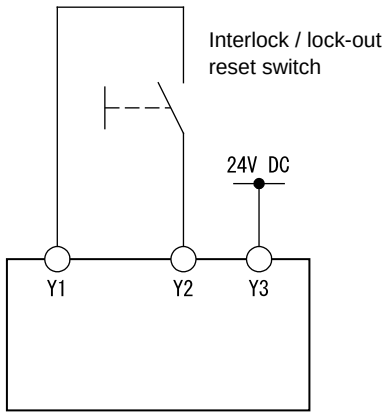
The reset switch must be installed in a place where the entire dangerous zone can be viewed, and in a way that the switch cannot be operated from the dangerous zone.

⚠CAUTION

The safety category is determined by the entire safety control system. Design and use it in accordance with all the related standards. Consultation with an independent certification organization is recommended.

Wiring for reset inputs

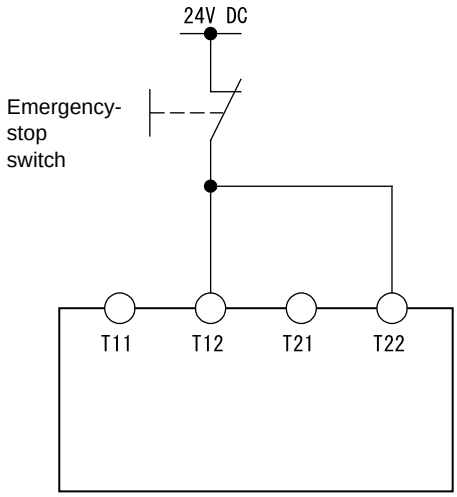
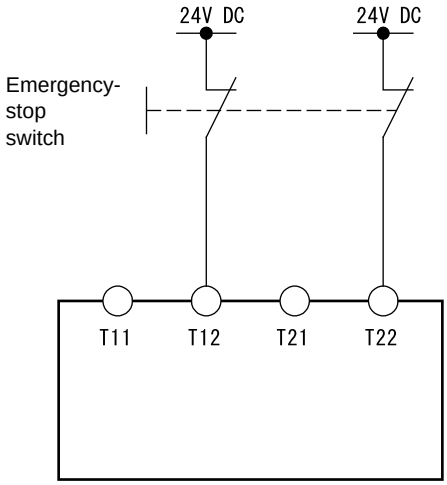
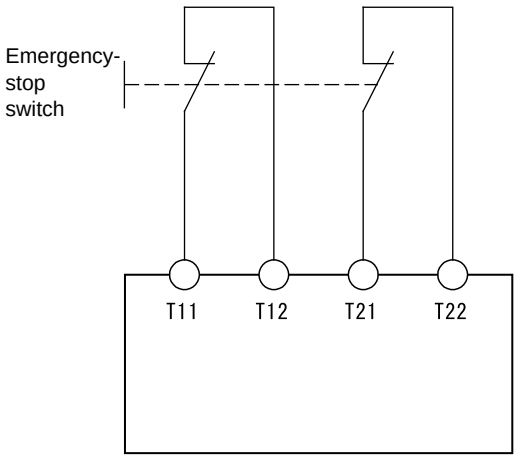
Interlock functions are set by the reset inputs wiring.

Reset mode	Terminal	Connection	Schematic diagram
Auto reset	Y2	Connect to 24V DC	 System reset switch (If an NC type switch is not connected, system reset cannot be activated. In such a case, turn the power ON again after turning it OFF to reset the system.)
	Y1/Y3	Connect as shown in the right figure	
Manual reset	Y3	Connect to 24V DC	
	Y1/Y2	Connect as shown in the right figure	

Note) In the auto reset mode, the detection function is made unavailable for the cases of trouble such as reset switch contact welding and short-circuiting between Y1-Y3.

Wiring for emergency-stop input

Cross-channel short-circuit monitoring functions are set by connecting the emergency-stop switches.

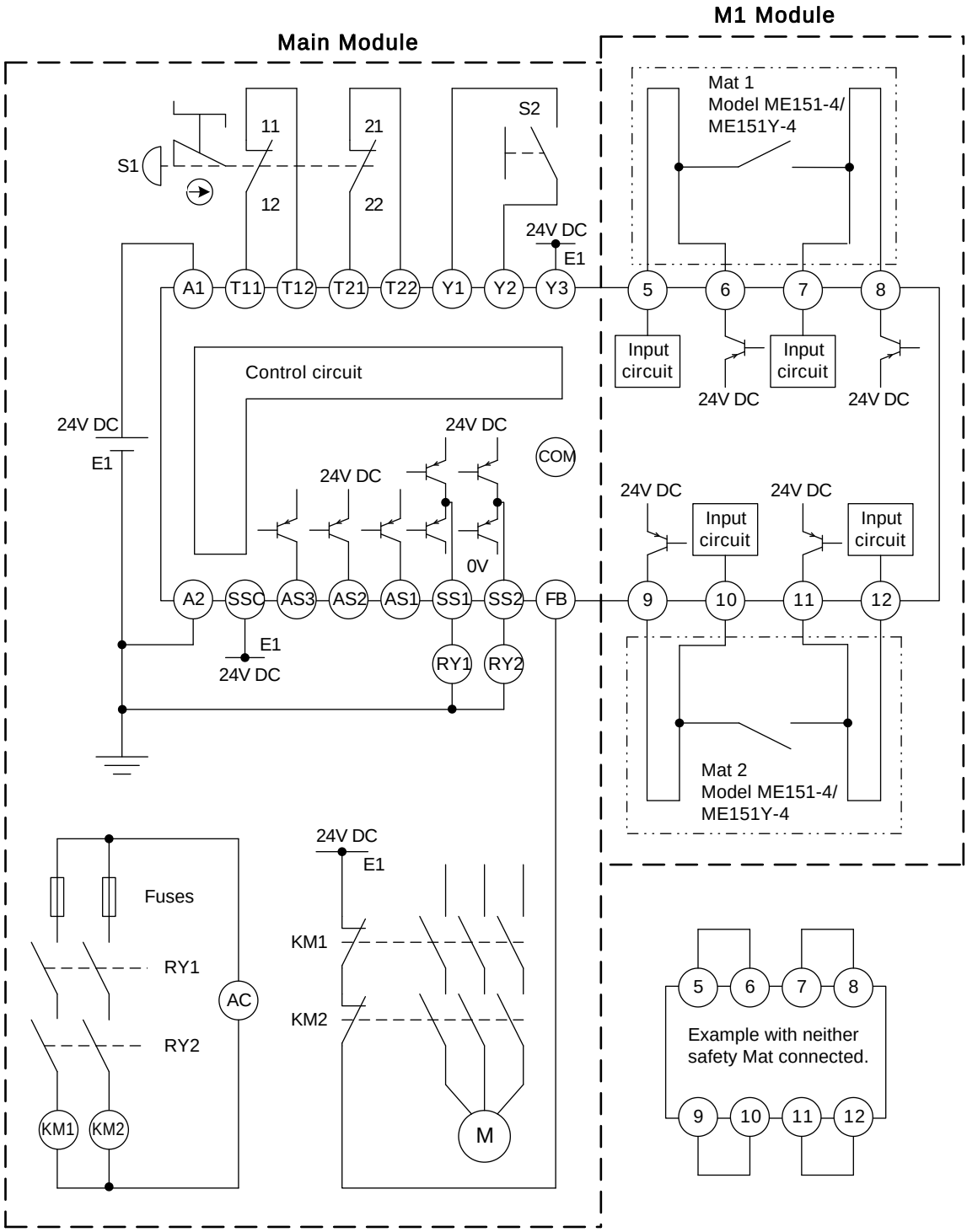
Cross-channel short-circuit monitoring	Safety category	Connection	Schematic diagram
None	2	Connect the switches between 24V DC and T12, T22.	
	3	Connect the switches between 24V DC and T12, T22.	
Available	4	Connect the switches between T11 and T12, and T21 and T22, respectively.	

Example of wiring and operation chart

■ Model F3SX-EM1 (Manual reset)

▪ Example of wiring

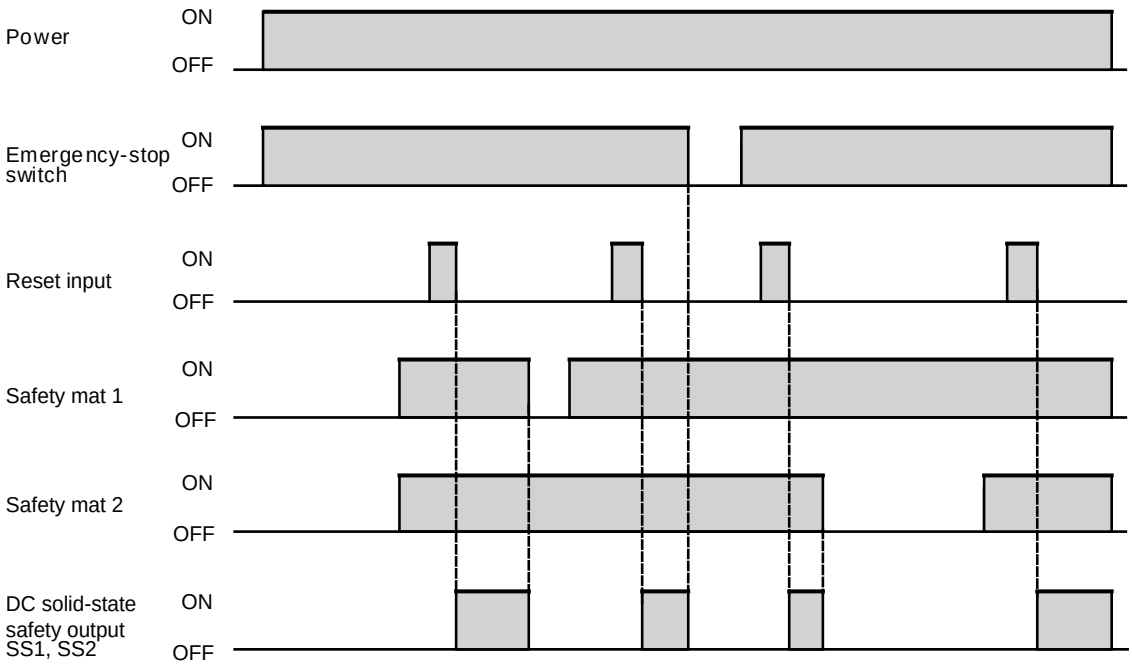
Note: F3SX-E-M1M1R incorporates 2 sets of M1 module.



S1 : Emergency-stop switch (positive opening contacts) (Model A165E,Model A22E)
S2 : Reset switch
KM1, KM2 : Magnetic contactor
RY1, RY2 : Relay
M : 3 phase motor
E1 : 24V DC power source (Model S82K)

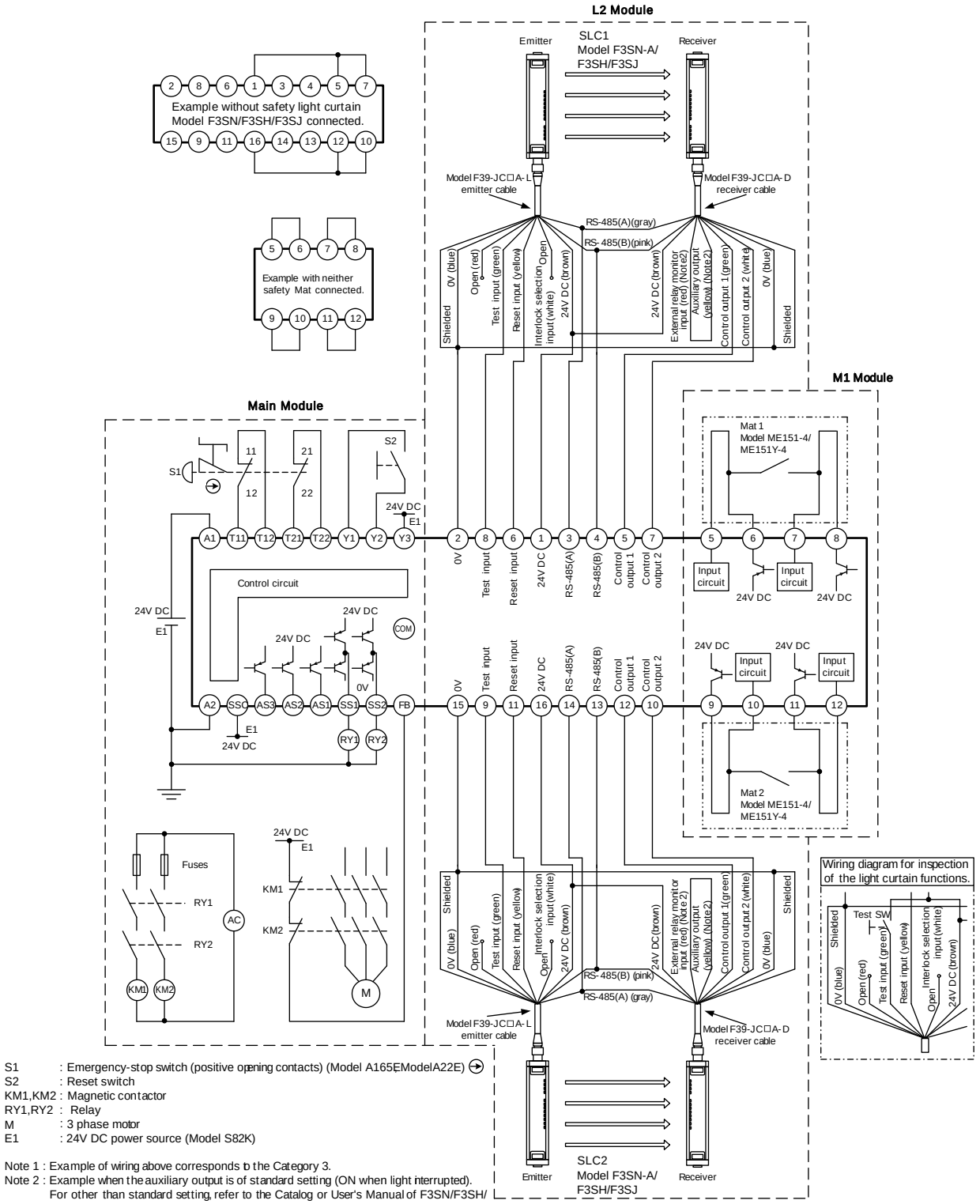
Note 1 :Example of wiring above corresponds to the Category 3.
Note 2 :Example of wiring above corresponds to the Stop Category (EN60204-1) 0.

▪ Operation chart



■ Model F3SX-E-L2M1 (Manual reset)

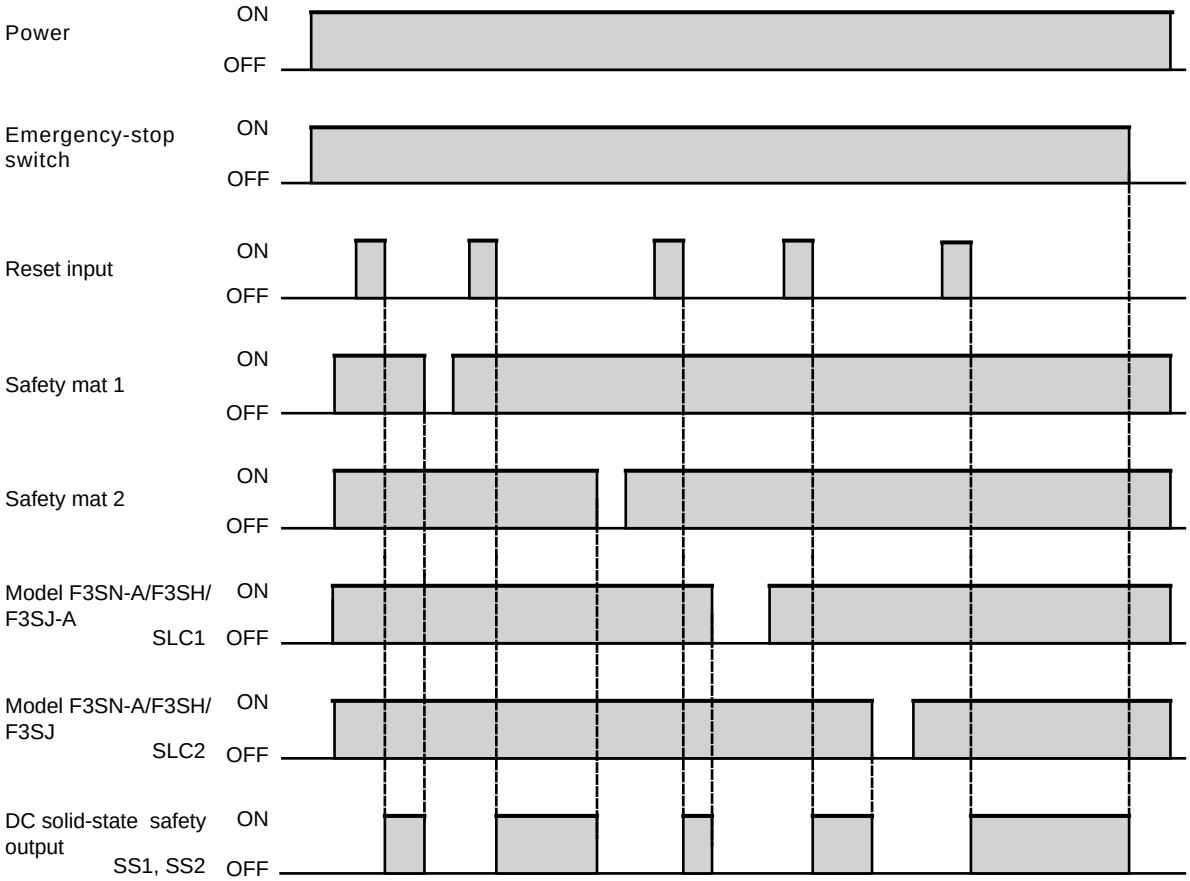
▪ Example of wiring



S1 : Emergency-stop switch (positive opening contacts) (Model A165EModelA22E)
S2 : Reset switch
KM1,KM2 : Magnetic contactor
RY1,RY2 : Relay
M : 3 phase motor
E1 : 24V DC power source (Model S82K)

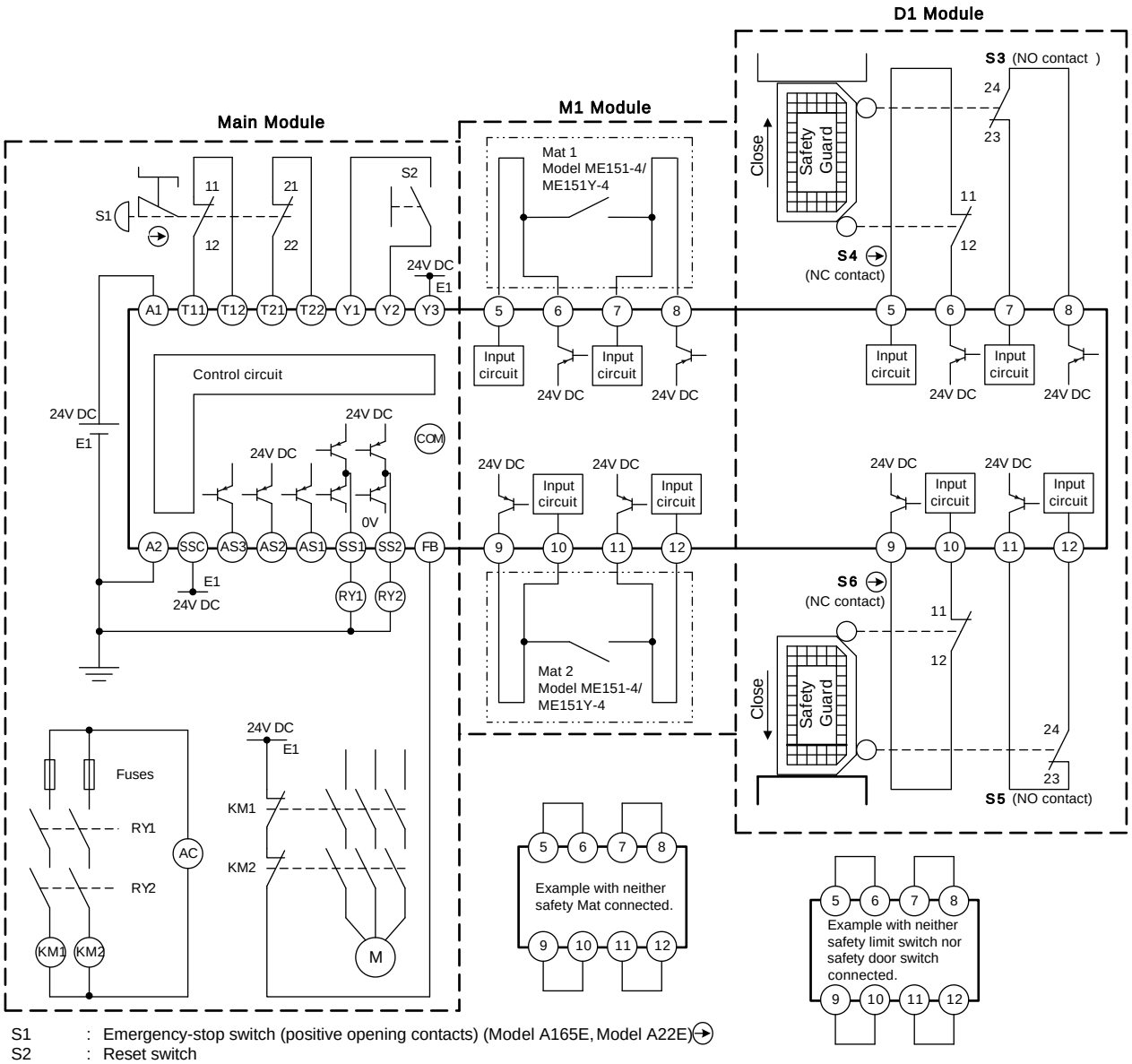
Note 1 : Example of wiring above corresponds to the Category 3.
Note 2 : Example when the auxiliary output is of standard setting (ON when light interrupted).
For other than standard setting, refer to the Catalog or User's Manual of F3SN/F3SH/F3SJ.
Note 3 : Example of wiring above corresponds to the Stop Category (EN60204-1) 0

▪ Operation chart



■ Model F3SX-E-M1D1 (Manual reset)

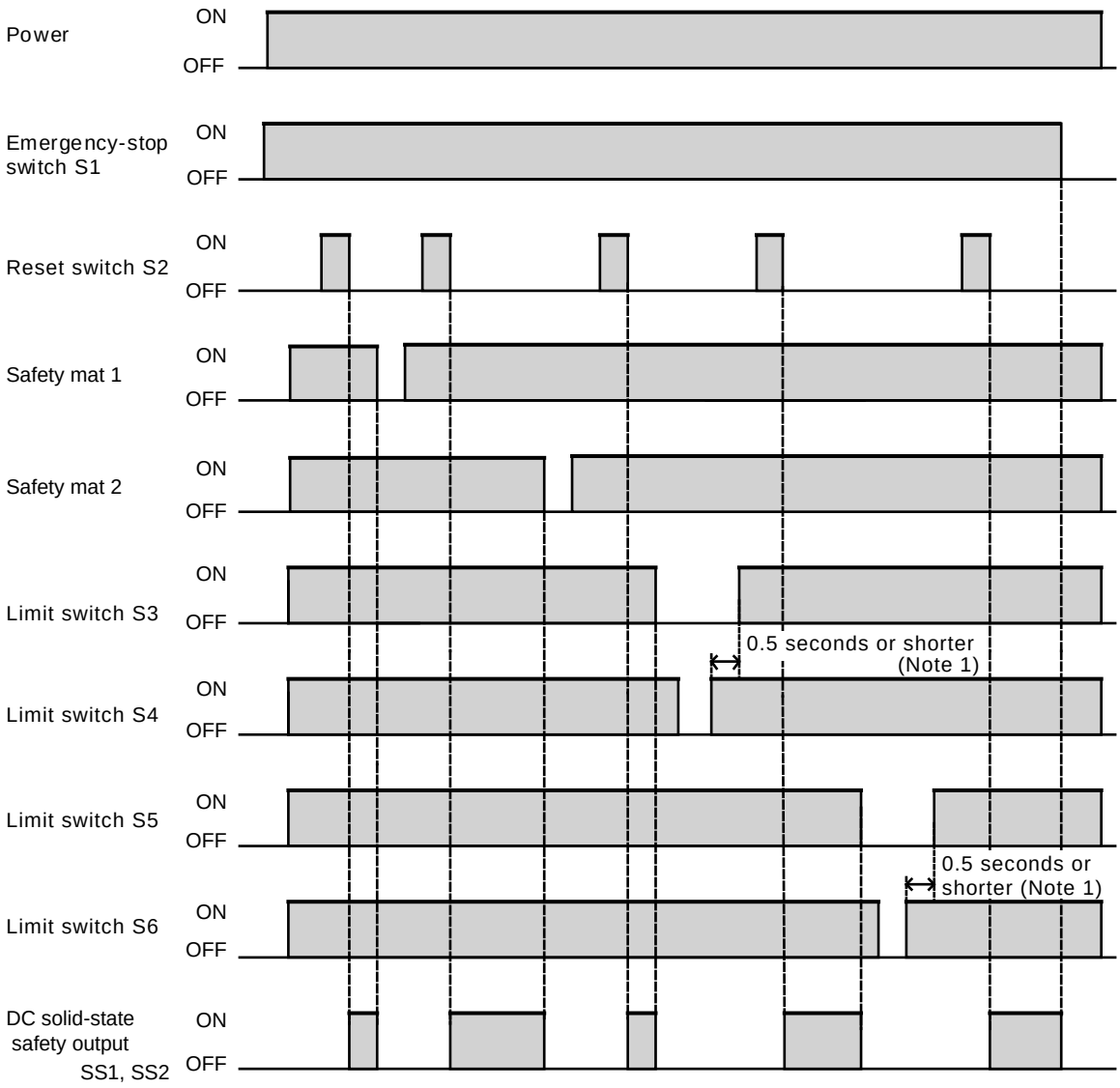
▪ Example of wiring



S1 : Emergency-stop switch (positive opening contacts) (Model A165E, Model A22E)
S2 : Reset switch
S3, S5 : Limit switch
S4, S6 : Safety limit switch (positive opening contacts) (Model D4N, Model D4B)
KM1, KM2: Magnetic contactor
RY1, RY2: Relay
M : 3 phase motor
E1 : 24V DC power soure (Model S82K)

Note 1 :Example of wiring abo ve corresponds to the Category 3
Note 2 :Example of wiring above cor responds to the Stop Category (EN60204-1) 0.

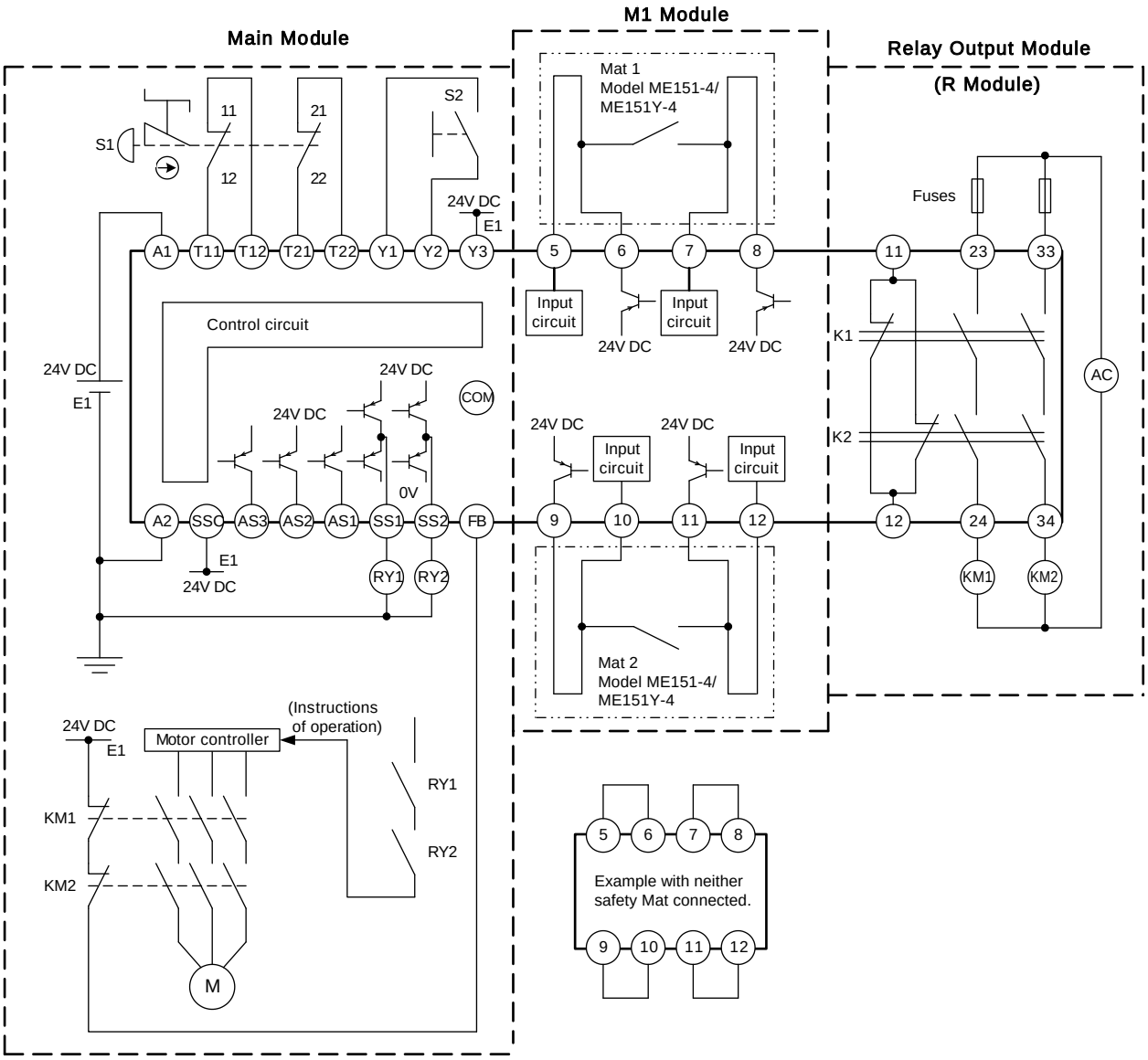
▪ Operation chart



(Note 1) Operates at the next reset switch input only if input time difference is within 0.5 seconds.

■ Model F3SX-E-M1R (Manual reset)

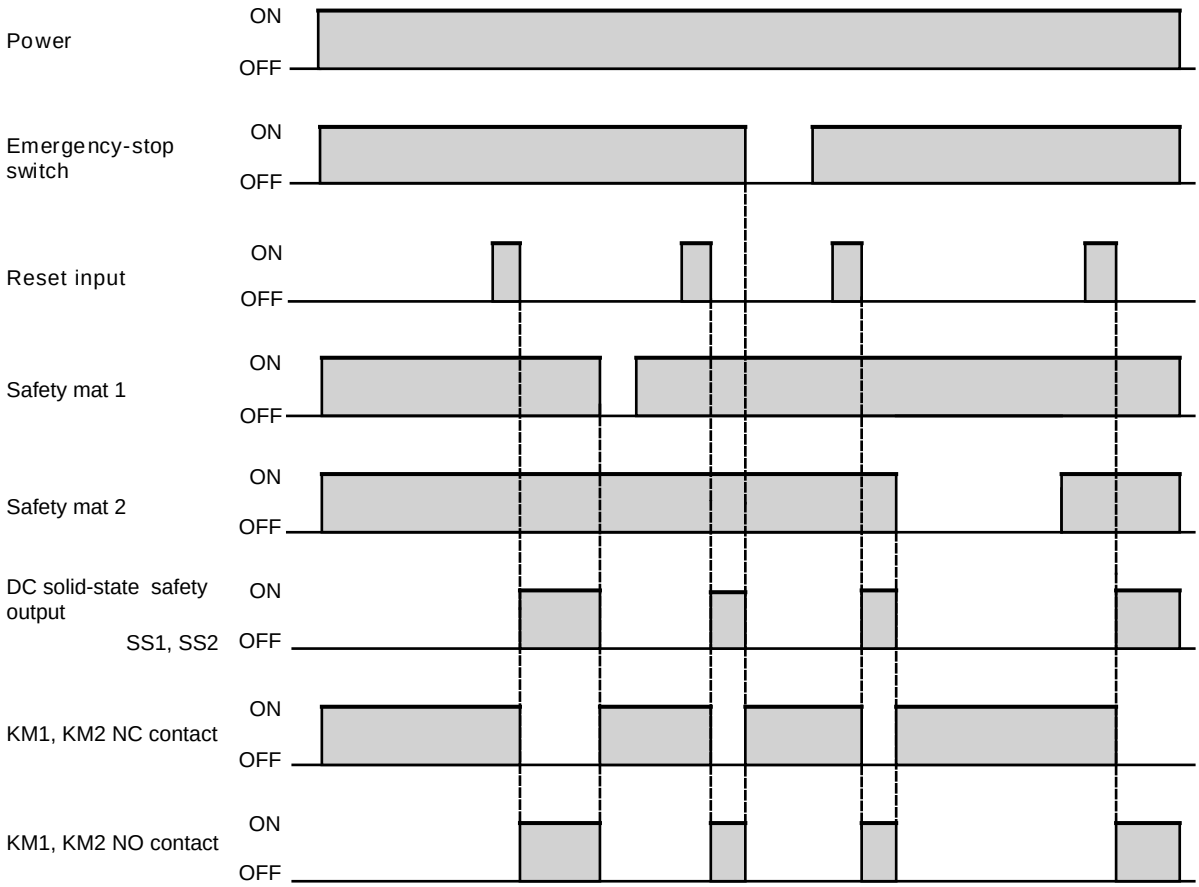
▪ Example of wiring



S1 : Emergency-stop switch (positive opening contacts) (Model A165E, Model A22E) ⊕
S2 : Reset switch
KM1, KM2: Magnetic contactor
RY1, RY2: Relay
M : 3 phase motor
E1 : 24V DC power source (Model S82K)

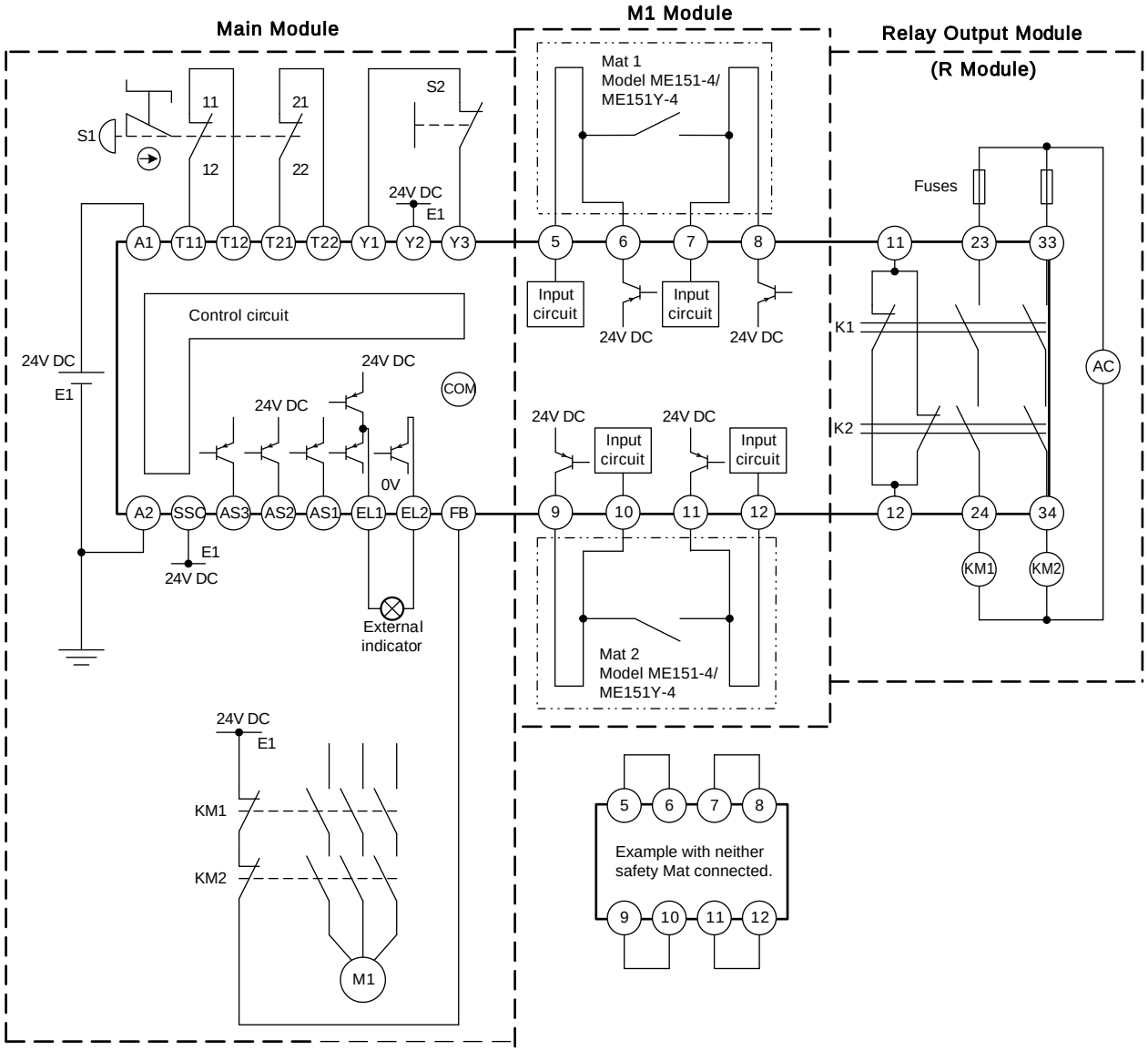
Note 1 :Example of wiring above corresponds to the Category 3.
Note 2 :Example of wiring above corresponds to the Stop Category (EN60204-1) 0.

▪ Operation chart



■ Model F3SX-N-M1R (Manual reset)

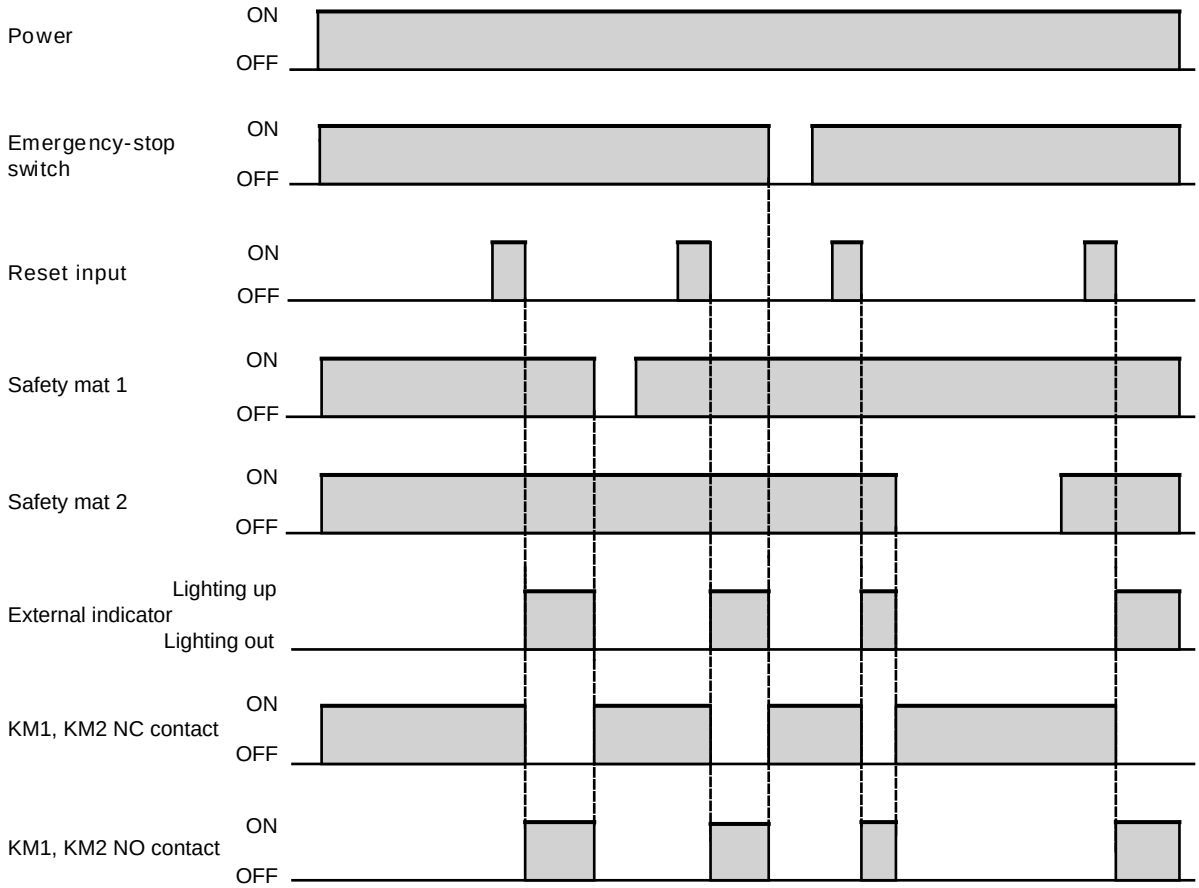
▪ Example of wiring



S1 : Emergency-stop switch (positive opening contacts) (Model A165E, Model A22E) ➔
S2 : Reset switch
KM1, KM2: Magnetic contactor
M : 3 phase motor
E1 : 24V DC power source (Model S82K)
External indicator: Filament type indicator
When any external indicat or is not used, connect a resistor (1/4W, 4.7kΩ)

Note 1 :Example of wiring above corresponds to the Category 3.
Note 2 :Example of wiring above corresponds to the Stop Category (EN60204-1) 0.

▪ Operation chart



MEMO

Chapter 3
Specifications of Output Module

Specifications of Relay Output Module 3-2
- Each name and functions 3-2
- Internal schematic diagram 3-2

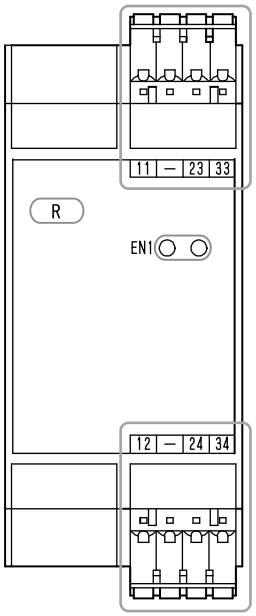
Specifications of Relay Output Module (ON-delay output) 3-3
- Each name and functions 3-3
- Internal schematic diagram 3-3

Specifications of Relay Output Module (OFF-delay output) 3-4
- Each name and functions 3-4
- Internal schematic diagram 3-4
- Operation chart 3-5

Specifications of Relay Output Module

This module (R module) is the relay output module with NON-delay output (Instant breaking).

Each name and functions



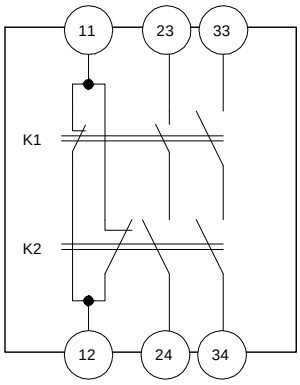
■ LED

Indication	Color	Name	Functions
EN1	Green	Safety relay output ON indicator	Lights up when safety relay output is ON.
EN1	Red	Safety relay output OFF indicator	Lights up when safety relay output is OFF.

■ Output terminal

	Terminal No.	Functions
Relay output	11, 12	Auxiliary relay output (NC)
	23, 24	Safety relay output (NO)
	33, 34	Safety relay output (NO)

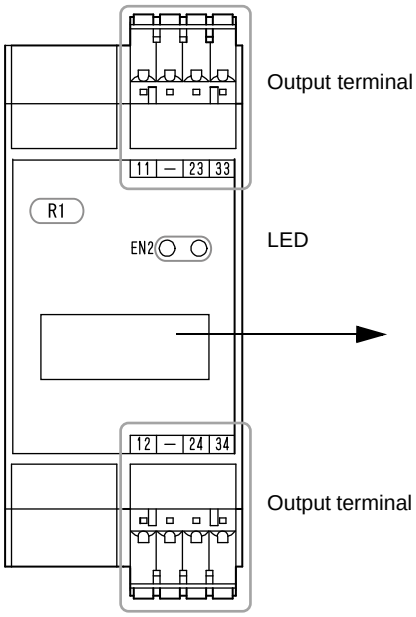
Internal schematic diagram



Specifications of Relay Output Module (ON-delay output)

This module (R1 module) is the relay output module (with ON-delay output).

Each name and functions


Output terminal
11 – 23 33
R1
EN2
LED
CHECK!
Use this area to write the data for the delay time set by the function set-up software for model F3SX (Model F3SX-CD□□□, sold separately).
12 – 24 34
Output terminal

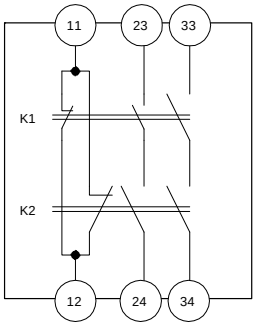
■ LED

Indication	Color	Name	Functions
EN2	Green	Safety relay output ON indicator	Lights up when safety relay output is ON.
EN2	Red	Safety relay output OFF indicator	Lights up when safety relay output is OFF. During the ON-delay operation, it flashes in the cycles shown below. (Residual ON-delay time is 20 seconds or more : 1Hz cycle Residual ON-delay time is 10 seconds or more : 2Hz cycle Residual ON-delay time is 5 seconds or more : 3Hz cycle Residual ON-delay time is less than 5 seconds : 4Hz cycle)

■ Output terminal

	Terminal No.	Functions
Relay output	11, 12	Auxiliary relay output (NC) (ON-delay output)
	23, 24	Safety relay output (NO) (ON-delay output)
	33, 34	Safety relay output (NO) (ON-delay output)

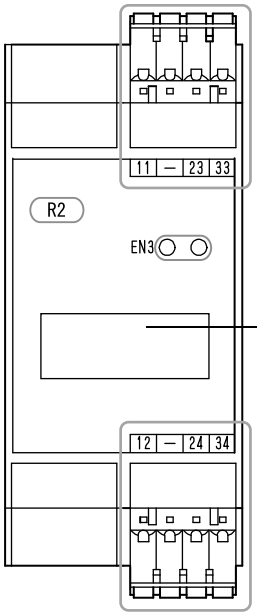
Internal schematic diagram



Specifications of Relay Output Module (OFF-delay output)

This module (R2 module) is the relay output module (with OFF-delay output).

Each name and functions


Output terminal
11 – 23 33
R2
EN3
LED
CHECK!
Use this area to write the data for the delay time set by the function set-up software for model F3SX (Model F3SX-CD□□□, sold separately).
12 – 24 34
Output terminal

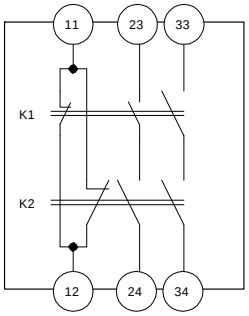
■ LED

Indication	Color	Name	Functions
EN3	Green	Safety relay output ON indicator	Lights up when safety relay output is ON. During the OFF-delay operation, it flashes in the cycles shown below. (Residual OFF-delay time is 20 seconds or more: 1Hz cycle Residual OFF-delay time is 10 seconds or more: 2Hz cycle Residual OFF-delay time is 5 seconds or more : 3Hz cycle Residual OFF-delay time is less than 5 seconds: 4Hz cycle)
EN3	Red	Safety relay output OFF indicator	Lights up when safety relay output is OFF.

■ Output terminal

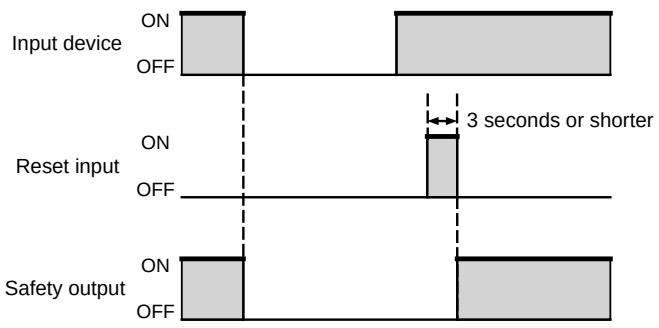
	Terminal No.	Functions
Relay output	11, 12	Auxiliary relay output (NC) (OFF-delay output)
	23, 24	Safety relay output (NO) (OFF-delay output)
	33, 34	Safety relay output (NO) (OFF-delay output)

Internal schematic diagram



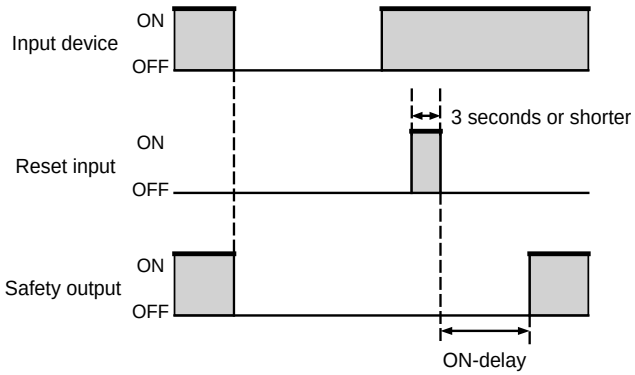
Operation chart

- With R module



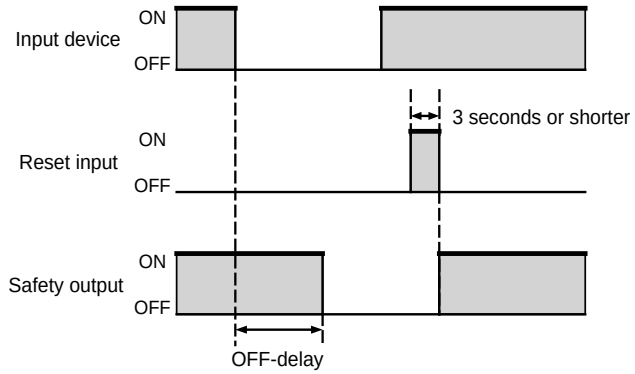
In the manual reset mode;
The safety output turns OFF immediately after the input device turns OFF. And, with all the input devices in the ON state, the safety output turns ON immediately after the interlock reset is input.

- With ON-delay set out in R1 module (Note 1)



In the manual reset mode;
With all the input devices in the ON state, the safety output turns ON when the ON-delay time elapsed after the interlock reset is input.

- With OFF-delay set out in R2 module (Note 2)



In the manual reset mode;
The safety output turns OFF when the OFF-delay time elapsed after the input device turns OFF.

(Note 1)The ON-delay time can be set to the R1 module (23/24 terminals, 33/34 terminals). The ON-delay time can be set to the time in the range from 0.1 to 600 seconds with the function set-up software for model F3SX (Model F3SX-CD□□□, sold separately). For the details, confirm with HELP of Model F3SX-CD□□□.
The ON-delay time is set to “0 seconds” at the factory shipment.

(Note 2)The OFF-delay time can be set to the R2 module (23/24 terminals, 33/34 terminals). The OFF-delay time can be set to the time in the range from 0.1 to 600 seconds with the function set-up software for model F3SX (Model F3SX-CD□□□, sold separately). For the details, confirm with HELP of Model F3SX-CD□□□.
The OFF-delay time is set to “0 seconds” (NON-delay (Instant breaking)) at the factory shipment.

⚠WARNING

Never use with a load in excess of the trip capacity (contact voltage, contact current).
Doing so may damage the output circuit and cutoff may not be possible.

With regard to the relay output, install a fuse in series with the output contacts.

Contacts protection for safety relay outputs p.14

⚠CAUTION

The life duration of the relays varies depending on the switching conditions or loads, etc. Use the relays within the specified switching frequency limits for the actual devices under actual conditions.

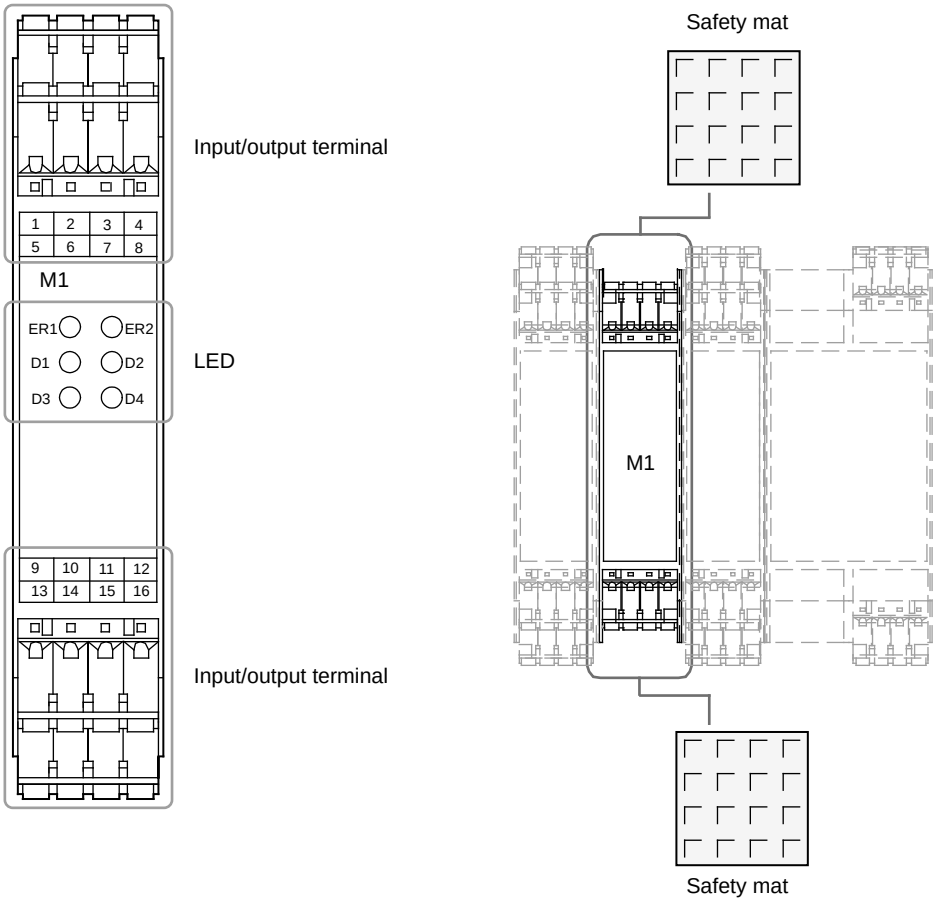
Chapter 4
Specifications of Input Module

Safety Mat Input Module	4-2
Each name and functions	4-2
Wiring diagram	4-4
Light Curtain Input Module	4-6
Each name and functions	4-6
Wiring diagram	4-8
Safety Door Switch Input Module	4-11
Each name and functions	4-11
Wiring diagram	4-12
Connection of Input Devices	4-13

Safety Mat Input Module

This module (M1 module) is the input module for safety mat.

Each name and functions



■ LED indicator

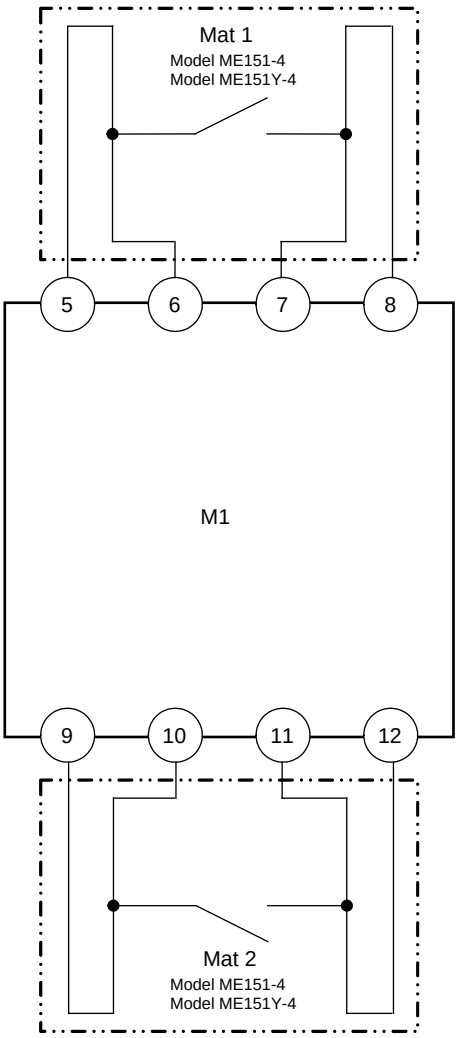
Indication	Color	Name	Functions
ER1	Red	Error indicator	Flashes when Terminal 5 or Terminal 7 input error occurs. 1 flash : Breaking of wire. 2 flashes : Failure or mis-wiring of input circuit.
ER2	Red	Error indicator	Flashes when Terminal 6 or Terminal 8 input error occurs. 1 flash : Breaking of wire. 2 flashes : Failure or mis-wiring of input circuit.
D1	Green	Terminal 5 input indicator	Lights up for Terminal 5 input.
D2	Green	Terminal 6 input indicator	Lights up for Terminal 6 input.
D3	Green	Terminal 7 input indicator	Lights up for Terminal 7 input.
D4	Green	Terminal 8 input indicator	Lights up for Terminal 8 input.

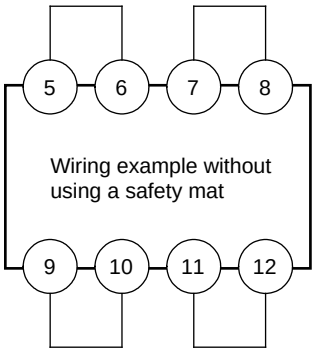
■ Input/output terminal

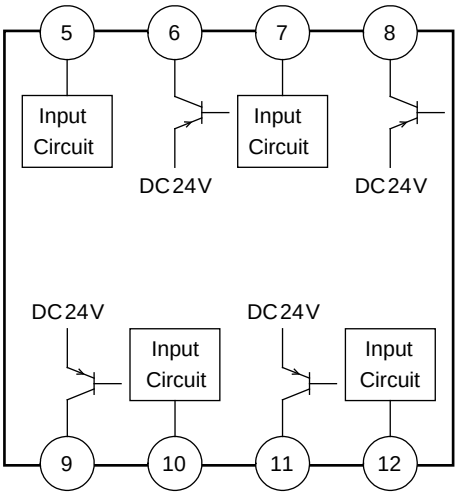
Terminal No.	Connection	
1	Not used.	
2		
3		
4		
5	Safety mat Miller Edge Model ME151-4 Model ME151Y-4	First connection area
6		
7		
8		
9	Safety mat Miller Edge Model ME151-4 Model ME151Y-4	Second connection area
10		
11		
12		
13	Not used.	
14		
15		
16		

(Note 1) Connect terminals 5 and 6, and 7 and 8 directly if a safety mat (1st set) is not connected.
(Note 2) Connect terminals 9 and 10, and 11 and 12 directly if a safety mat (2nd set) is not connected.

Wiring diagram







⚠WARNING

Measure the machine's maximum time for stopping on the actual system. Also, periodically check that the machine's time for stopping has not changed.

■ Calculation of Safety Distance

EN999 describes an expression for safety mat to be installed on a floor as;

S = (1600 x T) + 1200mm

S is configured as minimum safety distance (unit: mm), coefficient 1600 is configured at 1600mm/s as the standard approach speed,

T is time for stopping the whole machine, 1200mm is a length with consideration of a step and arm length of a man

Time for stopping the whole machine can be calculated by:

T = t1 + t2

t1 : Maximum time from start up of a detection device to turning OFF of control device's output

t2 : Response time of a machine. That is, required time to stop a machine or remove a hazard after receiving safety mat system's output.

Response time for calculation must be one fro the worst case. Some machines may have different response times for operation mode, type of workpiece, or stopping start point during a cycle. If wear of brake may affect the response time, it also should be taken into consideration.

<Calculation example>

In this example, a safety mat is used for a machine with measured maximum response time of 0.485 seconds. Here, t1 is assumed as 25ms.

From the expression above,

T = t1 + t2 = 25ms + 485ms = 510ms = 0.510s

S = (1600 x 0.510) + 1200mm = 816 + 1200mm = 2016mm

Thus safety mat must be installed up to 2016mm from a source of danger.

Note 1 : Design and installation of safety mat system with safety distance must comply to the product's specification.

Note 2 : Take undetectable areas of a safety mat into consideration such as external frame and corners.

■ Number of connections

- To connect more than 1 mat to 1 connection area, total capacity of mats and connection cable must be maximum capacity of controller inputs or less.
- Mat connection cable length must be 100m or less.

<Capacity for reference>

- Mat capacity: 1nF per square foot
- Mat connection cable (AWG16): 50pF per foot
- Maximum capacity of controller inputs: 0.09μF

⚠WARNING

Mat must be installed on a flat floor.

Light Curtain Input Module

This module (L2 module) is the input module for safety light curtain.

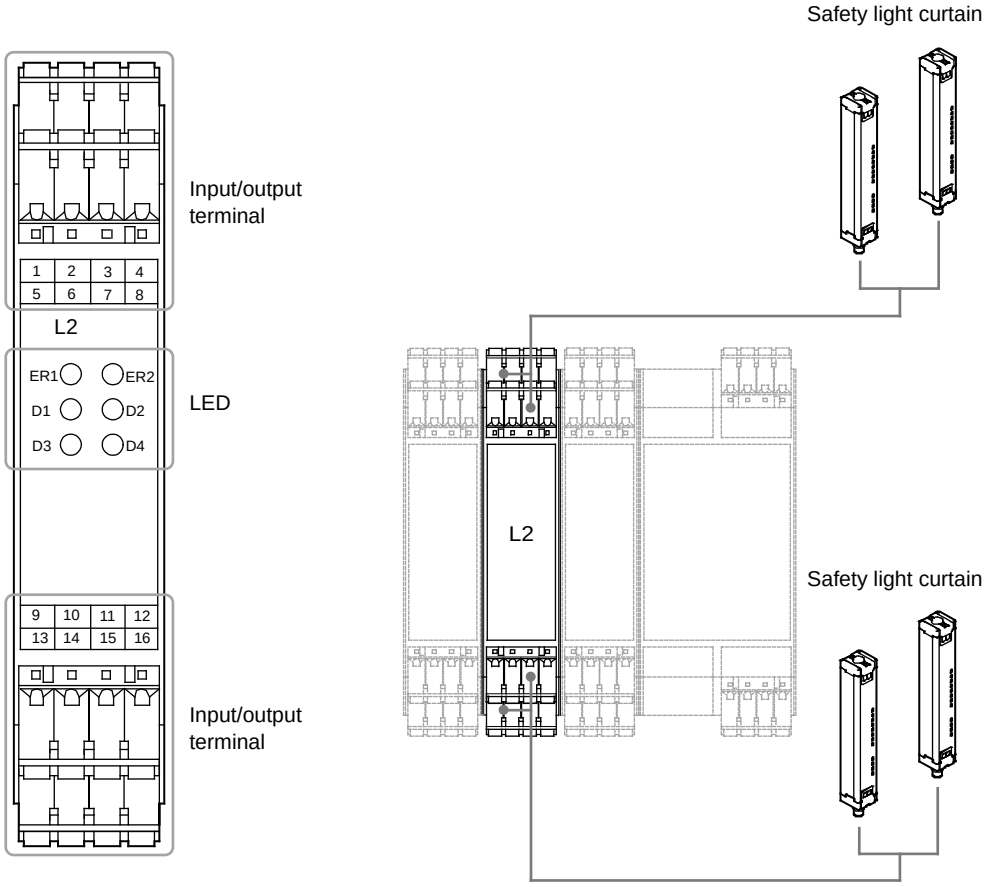
CHECK!

•The F3SX can supply electric power to a maximum of 4 sets of model F3SN/F3SH/F3SJ. If more than the above limitation is to be connected, power should be supplied externally from outside the F3SX. In such case, make it so the 24V DC and 0V lines of the external power supply for the F3SN/F3SH/F3SJ share the same line with the F3SX power supply.

•For using Model F3SN/F3SH/F3SJ in serial connection, external power supply is required.

Wiring diagram for the case the external power is supplied to the Model F3SN/F3SH/F3SJ p.4-10

Each name and functions



■ LED

Indication	Color	Name	Functions
ER1	Red	Error indicator	Lights up or flashes when Terminal 5 or Terminal 7 input error occurs. Light-up : Not synchronized between two terminal inputs 1 flash : Short-circuit or mis-wiring between two terminal inputs 2 flashes : Failure or mis-wiring of input circuit
ER2	Red	Error indicator	Lights up or flashes when Terminal 12 or Terminal 10 input error occurs. Light-up : Not synchronized between two terminal inputs 1 flash : Short-circuit or mis-wiring between two terminal inputs 2 flashes : Failure or mis-wiring of input circuit
D1	Green	Terminal 5 input indicator	Lights up for Terminal 5 input.
D2	Green	Terminal 7 input indicator	Lights up for Terminal 7 input.
D3	Green	Terminal 12 input indicator	Lights up for Terminal 12 input.
D4	Green	Terminal 10 input indicator	Lights up for Terminal 10 input.

■ Input/output terminal

Terminal No.	Connection	
1	24V DC	Safety light curtain (Set #1) OMRON Model F3SN-A series (Type 4) Model F3SN-B series (Type 2) Model F3SJ-A series (Type 4) or, multi-beam safety sensor ; OMRON Model F3SH series (Type 4)
2	0V	
3	RS-485(A)	
4	RS-485(B)	
5	Control output 1	
6	Reset input	
7	Control output 2	
8	Test input	
9	Test input	Safety light curtain (Set #2) OMRON Model F3SN-A series (Type 4) Model F3SN-B series (Type 2) Model F3SJ-A series (Type 4) or, multi-beam safety sensor ; OMRON Model F3SH series (Type 4)
10	Control output 2	
11	Reset input	
12	Control output 1	
13	RS-485(B)	
14	RS-485(A)	
15	0V	
16	24V DC	

(Note 1) If the safety light curtain (Set #1) is not connected, connect terminal 5 and terminal 7 directly with terminal 1.
(Note 2) If the safety light curtain (Set #2) is not connected, connect terminal 10 and terminal 12 directly with terminal 16.

CHECK!

- If the terminal 1 is short-circuited with the terminal 2, or otherwise, the terminal 15 is short-circuited with the terminal 16, the protection circuits discontinue the power supply through the terminals 1 and 16 automatically. Remove the causes of short-circuiting and recover by turning the main power ON again.
- When the Model F3SN/F3SH/F3SJ is brought into the lockout state, the release may be effective only by turning the power OFF and ON again. Recover those by doing so.

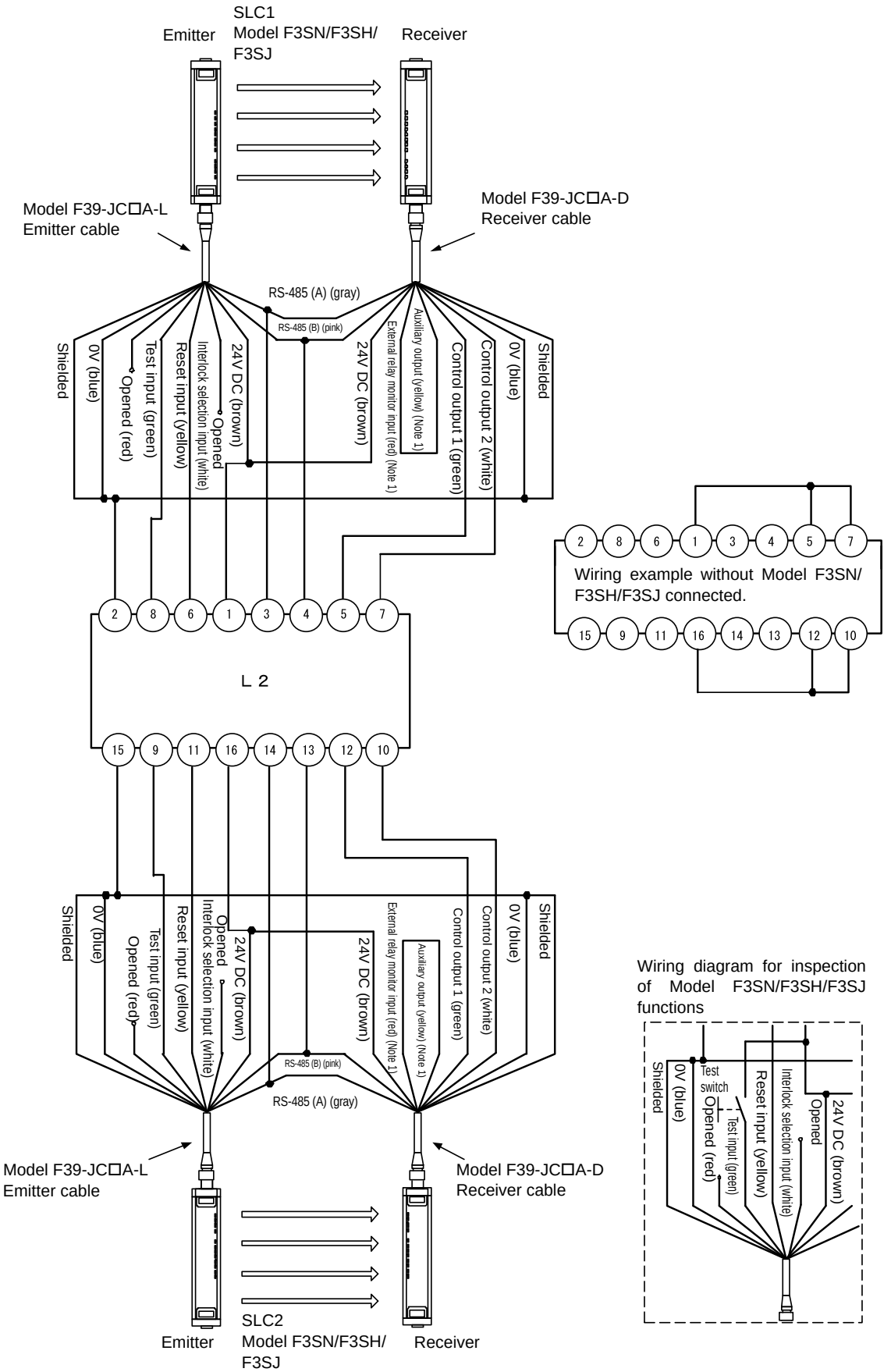
⚠WARNING

Never fail to secure the safety distances to the hazardous areas around the machine.

Be sure to align the devices so as to prevent mutual interference when using multiple safety light curtains, multi-beam safety sensors or single-beam safety sensors. Failure to do so may cause non-detectable conditions and a serious injury to humans.

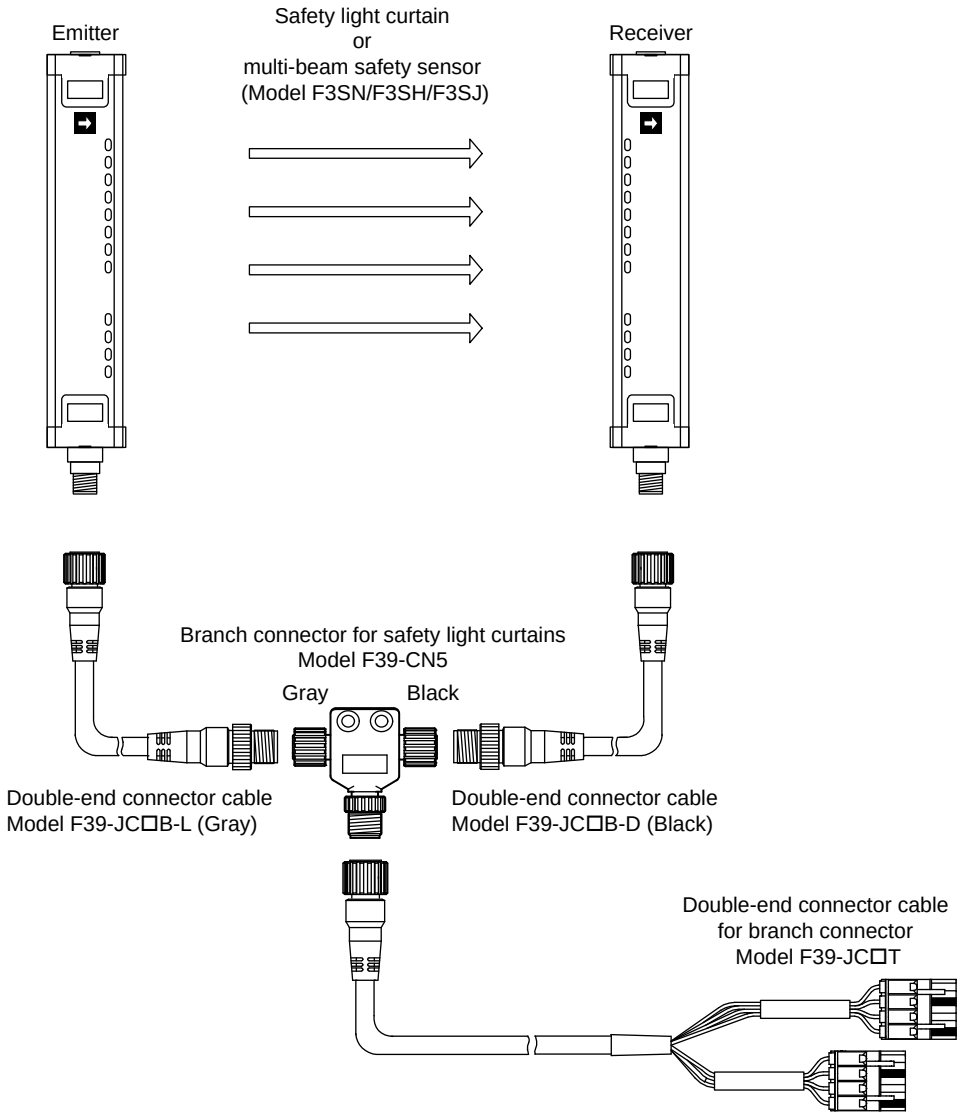
Note 1: Example when the auxiliary output is of standard setting (ON when light interrupted).
For other than standard setting, refer to the Catalog or User's Manual of F3SN/F3SH/F3SJ.

Wiring diagram



▪ Using a branch connector

Connector connection is possible using a branch connector for safety light curtains.



For the details of each model, refer to Chapter 6 Accessories.

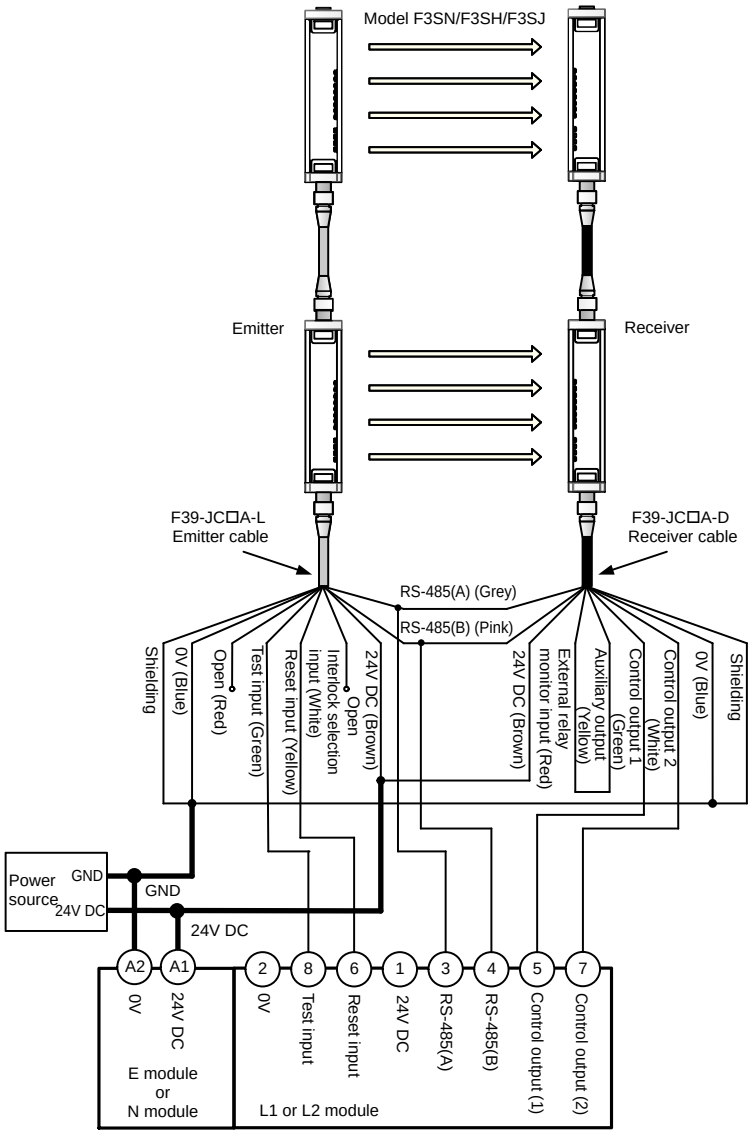
Accessories (sold separately) p.6-2

■ Wiring diagram for the case the external power is supplied to the Model F3SN/F3SH/F3SJ

When Model F3SN/F3SH/F3SJ is connected to the L1 module or L2 module, an F3SX can supply power source to one set of Model F3SN/F3SH/F3SJ through one connection terminal, or up to 4 sets of Model F3SN/F3SH/F3SJ through all of the connection terminals. Therefore, for supplying to sets of Model F3SN/F3SH/F3SJ in series or to 5 or more sets of Model F3SN/F3SX through the multiple connection terminals, an external power source is required as illustrated below. (Nonconformity to the stipulated wiring may cause a trouble.)

(How to change wiring)
1.Connect 24V DC line (brown) of the Model F3SN/F3SH/F3SJ to 24V DC of the external power source.
2.Connect 0V line (blue) of the Model F3SN/F3SH/F3SJ to 0V of the external power source.

(Notice)
* Use the power source identical to that of F3SX for supplying to the Model F3SN/F3SH/F3SJ.
* Be careful about the total current consumption (power capacity).
* It is not possible to use Model F3SN, Model F3SH and Model F3SJ in serial connection.

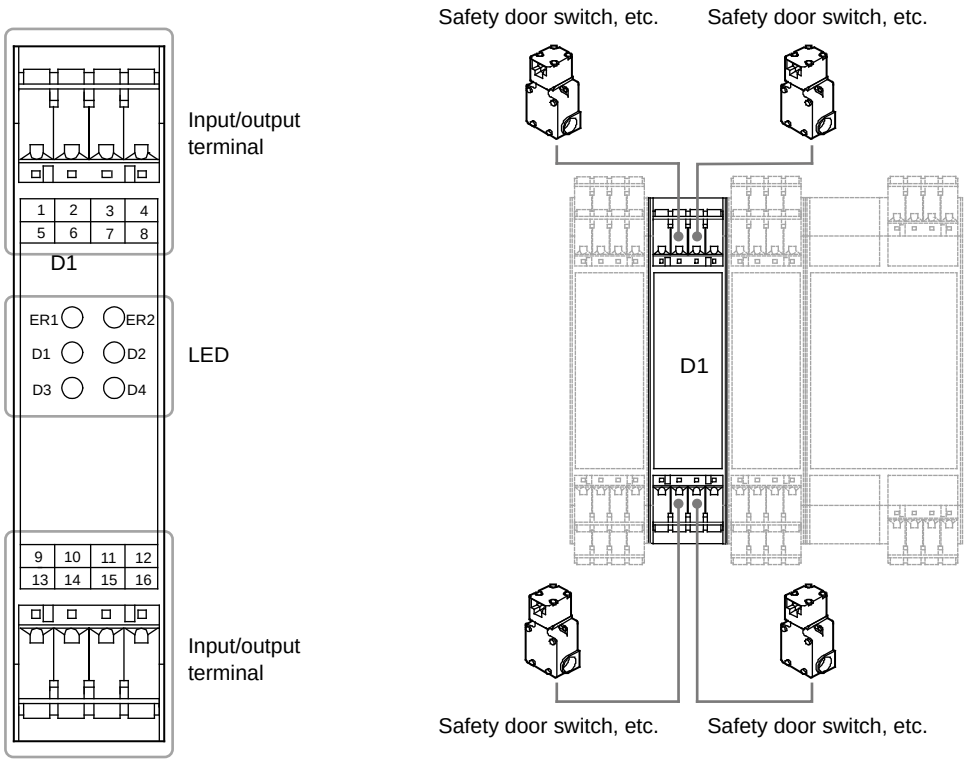


(Example of the wiring, where Model F3SN/F3SH/F3SJ is connected to either of the terminals 1 through 8 of the L2 module.)

Safety Door Switch Input Module

This module (D1 module) is the contact-type input device input module for use with safety door switch, etc.

Each name and functions



CHECK!

•Connect with safety door switch, safety limit switch or the like of contact type.

■ LED

Indication	Color	Name	Functions
ER1	Red	Error indicator	Lights up or flashes when Terminal 5 or Terminal 7 input error occurs. Light-up : Not synchronized between two terminal inputs 1 flash : Short-circuit or mis-wiring between two terminal inputs 2 flashes : Failure or mis-wiring of input circuit
ER2	Red	Error indicator	Lights up or flashes when Terminal 12 or Terminal 10 input error occurs. Light-up : Not synchronized between two terminal inputs 1 flash : Short-circuit or mis-wiring between two terminal inputs 2 flashes : Failure or mis-wiring of input circuit
D1	Green	Terminal 5 input indicator	Lights up for Terminal 5 input.
D2	Green	Terminal 7 input indicator	Lights up for Terminal 7 input.
D3	Green	Terminal 12 input indicator	Lights up for Terminal 12 input.
D4	Green	Terminal 10 input indicator	Lights up for Terminal 10 input.

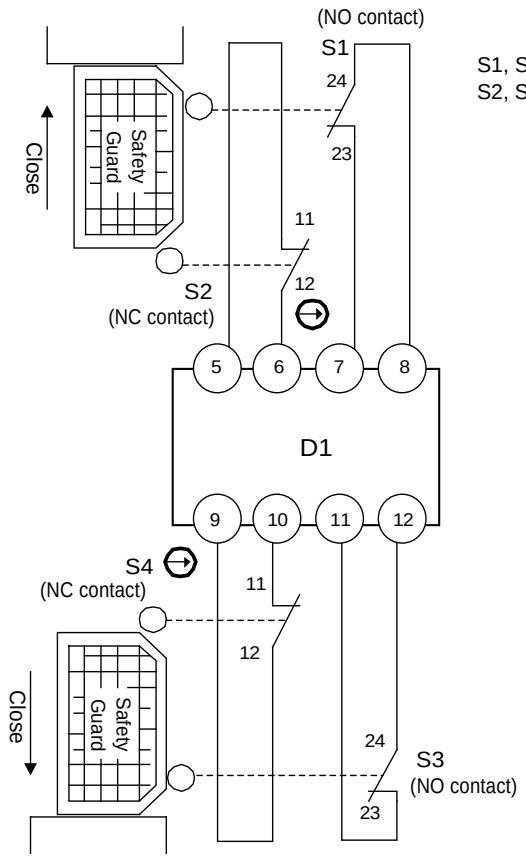
■ Input/output terminal

Terminal No.	Connection	
1	Not used.	
2		
3		
4		
5	Contacts such as safety limit switch or safety door switch.	Set #1
6		
7	Contacts such as safety limit switch or safety door switch.	
8		
9	Contacts such as safety limit switch or safety door switch.	Set #2
10		
11	Contacts such as safety limit switch or safety door switch.	
12		
13	Not used.	
14		
15		
16		

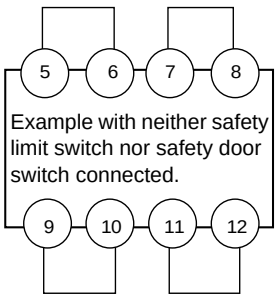
(Note 1) When any terminal is not connected with a (safety) limit switch or a door switch, it should be directly connected in the following combination.

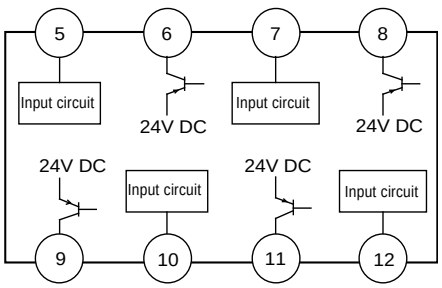
Terminals 5 and 6, terminals 7 and 8, terminals 9 and 10, and terminals 11 and 12.

Wiring diagram



S1, S3 : Limit switch
S2, S4 : Safety limit switch (positive opening mechanism) (Model D4N, Model D4B) ⊖





Connection of Input Devices

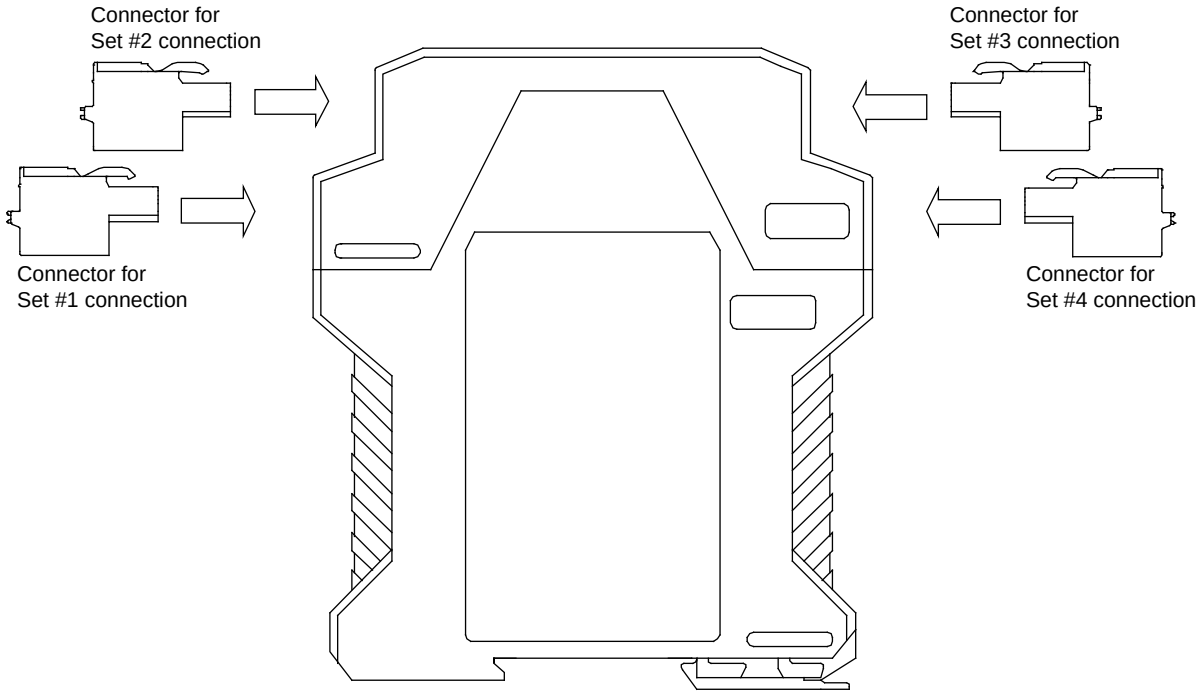


Figure as viewed from the main module side.

Connecting section	L2 module	D1 module	M1 module
Connector for Set #1 connection	Model F3SN/ F3SH/F3SJ (Set #1)	-	-
Connector for Set #2 connection		Safety door switch (Set #1)	Safety mat (First connection area)
Connector for Set #3 connection	Model F3SN/ F3SH/F3SJ (Set #2)	Safety door switch (Set #2)	Safety mat (Second connection area)
Connector for Set #4 connection		-	-

CHECK!

- In order to secure the safety functions use appropriate input devices to configure the system.
- Use the input device connectors in the order starting with Set #1.
- For wiring in the case that a device or devices are not in use, refer to the wiring diagram of each module.
- When wiring any devices, disconnect the power supply to F3SX and the devices to be connected.
- Wire around the input and output terminals properly with care.

MEMO

Chapter 5
Installation and Wiring

Installation	5-2
Placing into control board	5-4
Placing to DIN rail	5-5
Wiring	5-6
Connection between main body and terminal block	5-6
Processing of wire end	5-7
Connecting bar terminal to terminal block connector	5-9

Installation

⚠WARNING	
Do not operate the F3SX controller in a hazardous environment, such as an environment that contains flammable or explosive gas. Doing so may cause fire or explosion by electric arc generated in the internal relays or externally connected electromagnetic switches.	
A "Responsible Person" who is well aware of and familiar with the machine must implement the installation of the F3SX and confirmation thereafter. And the users must have thorough understanding about the relevant installation requirements, safe distances, control devices and the functions before starting operation.	
For the inspection and/or maintenance of the F3SX, a “Responsible Person“ must confirm that the work has been properly performed. Maintenance Services and Inspection p.6-30	

⚠CAUTION	
Use F3SX in an enclosure rated at least IP54 (IEC60529).	
For ventilation, allow for 5mm or more on both sides of the F3SX and 50mm or more above and beneath.	

⚠WARNING

In order for F3SX to satisfy EN60204-1, IEC61496-1 and UL508, have the DC power unit comply with all of the following requirements.

- Voltage within the rated (24V DC ± 10%).
- Do not share the power source with other devices or machines. When the power source is shared by mulitiple devices, consider margins for the total rated current.
- Compliant with the EMC Directive, for Industrial environments.
- Double or reinforced insulation between the primary and secondary circuits.
- Automatic recovery of over-current protection characteristics (voltage drop).
- 20ms or over of the output hold time.
- Satisfies the output characteristics requirements of a class 2 circuit or equivalent limited energy circuit, as stipulated in UL508.
- Compliant with the laws and standards in relation to EMC and other electric device safety in the country or area where this unit is used. (Example: EMC Directive and Low Voltage Directive in EU.)

When using a commercialized switching regulator, be sure to ground FG (frame ground terminal).
(If not grounded, it may cause erroneous operations due to the switching noises.)

[Remark]

The power supply must conform to the following requirement (1) or (2) regarding a secondary circuit, in accordance with UL 508,to avoid a fire.

(1) With regard to the limited current and voltage circuit with power supplied by the isolated source such as the secondary winding of an isolating transformer:
-the current is limited to 8A max. (including when short-circuited). Or,
- a circuit protector to regulate the current such as a fuse is used and its rating should be 4.2A max.
(at 24V DC power source)

Recommended power supply :Model S82K (50W, 90W type) manufactured by OMRON Corporation.
This model is UL listing certified (UL508, Class 2), and is compliant with CE marking (EMC/Low Voltage Directive).

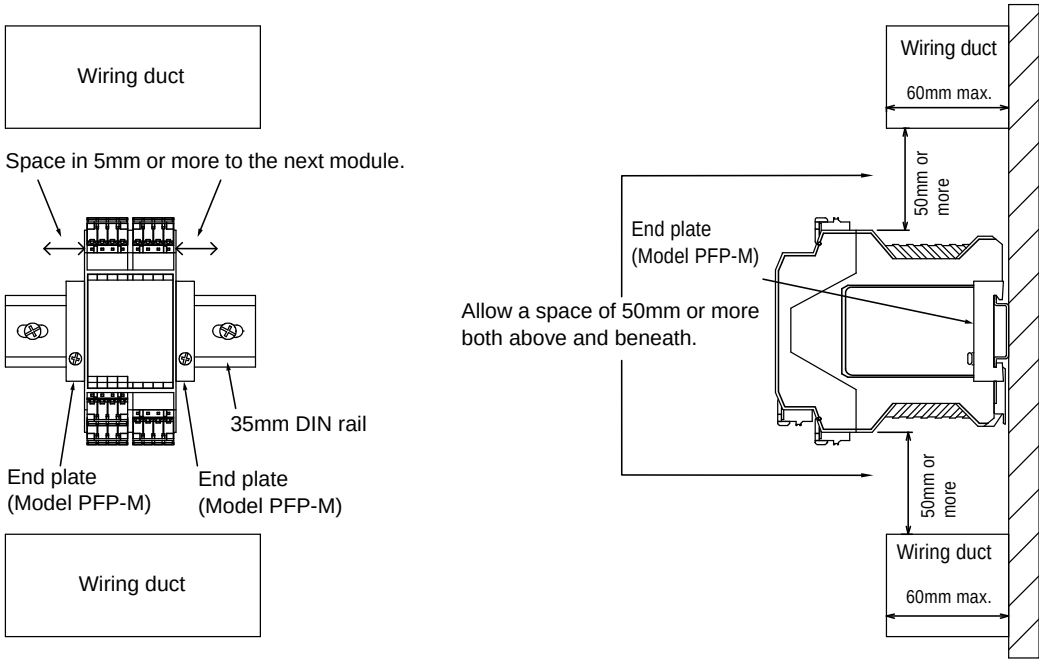
(2) Circuits with a Class 2 power supply pursuant to UL1310 or with the power source supplied by a Class 2 transformer pursuant to UL1585.

Placing into control board

⚠CAUTION

If the DIN rail is too short for the width of F3SX, the product may drop out of the rail by vibration.
Use end plate (Model PFP-M, sold separately), to fix F3SX on the DIN rail where necessary.

- Use DIN rail (35mm-wide) for placing the main body into the control board.
- Locate the wiring duct and main body on an appropriate position so that they cause no trouble to occur with placement/displacement of the unit, connection/disconnection of the connectors, or heat release of the unit. Use of the wiring duct of 60mm high or less is recommended.
- Allow for 5mm or more on both sides of the module and 50mm or more above and beneath.



(Unit:mm)

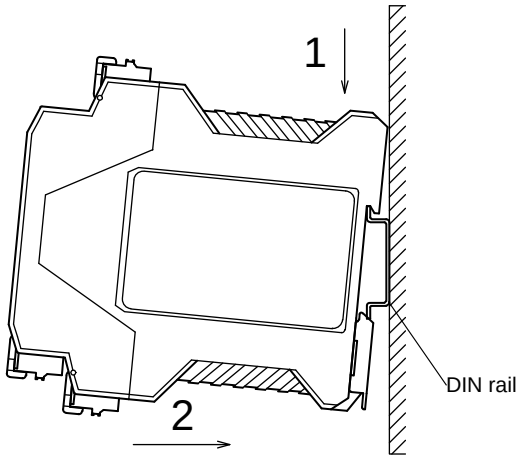
- Use within the rated extent regarding the circumstances in the control panel.

Items	Rating
Ambient temperature	Operating: -10 to +50°C (no freezing or condensation)
Ambient humidity	35 to 85%RH (no freezing or condensation)
Vibration resistance	10 to 55Hz double amplitude of 0.7mm each in X, Y and Z direction, 20 sweeps (with power on)
Shock resistance	100m/s^2 each in X, Y and Z direction, 1000 times (with power on)

Placing to DIN rail

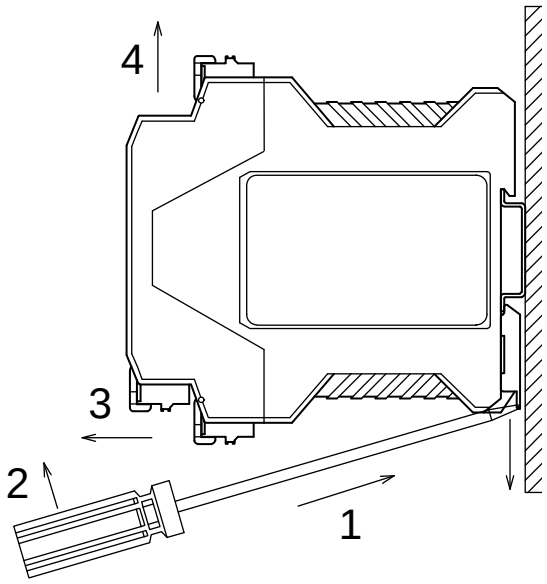
■ Placement

1. Hang the upper hook on the rail.
2. Push the main body until the lower hook is locked.



■ Displacement

1. Insert the edge of a flat-blade screw driver in the slot of the hook.
2. Draw the hook downward.
3. Pull the main body forward to remove it from the rail.
4. Hold the main body upward.



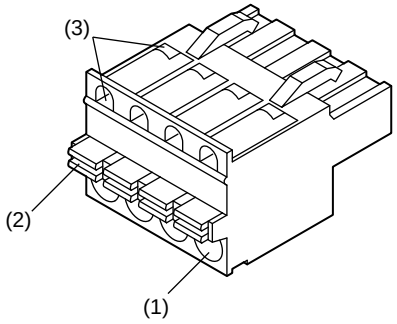
Wiring

⚠WARNING

Wiring must be done while the power is turned OFF either for F3SX or the devices connected with it. Doing it with the power ON may cause an electric shock. And external devices in connection with this product may behave in an unexpected way.

Connection between main body and terminal block

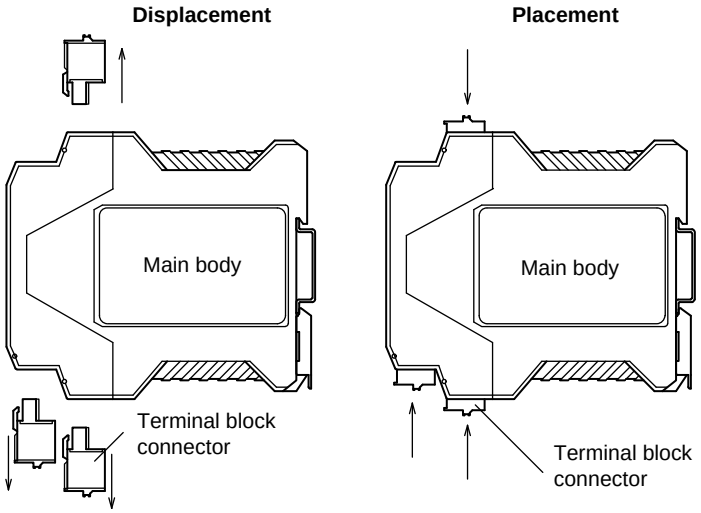
■ Each part name and functions of terminal block



Number	Name	Functions
(1)	Wire insertion slot	Fix the wire within.
(2)	Wire release button	Push this button to take out the wire.
(3)	Tester probe point	Contact the tester probe at this position.

■ Placement / displacement of terminal block connector

The terminal block connector is mounted at the factory shipment. Displace the terminal block connector when making wiring.



⚠CAUTION

Be careful not to catch a finger in the connector when installing it.

CHECK!

- The terminal block connector is provided with the protection key against erroneous wrong connectiion between the AC and the DC lines by mistake. (The “key” herein is the red board part attached to the entry of the terminal block connector. Two of the keys are attached to each terminal block connector.) However, the insertion could be made if attempted forcefully or in a particular angle. The anti-erroneous insertion key is only a visual prevention mean but not of a structure to prevent an erroneous insertion. Ensure the wiring before inserting the connector.
- Also, do not the terminal block connectors attached to the relay output module with any of other modules.

Processing of wire end

■ Wiring materials

Select to use wiring materials conforming to the required standards.

Recommended materials and tools p.6-4

⚠CAUTION

Stranded wire should be processed with insulation-covered bar terminal (DIN46228-4 standard compatible type) at its ends before using for connection.
Conforming wire (when using recommended bar terminals): 0.34 to 1.5mm^2 AWG22 to 16

■ Processing of wire end

1. Uncover the insulation of the wire.

Length to uncover should meet the bar terminal to be used.

2. Insert the wire edge to the bar terminal.

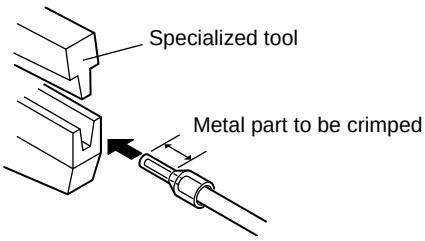
Use bar terminals compatible with the terminal block.

3. The wire end is to be inserted in the bar terminal.

Confirm that the wire insulation is contained in the insulation cover of the bar terminal.

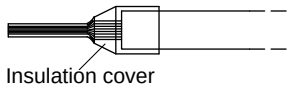
4. Crimp the metal part with the specialized tool.

Use the crimping tool compatible with the bar terminal.

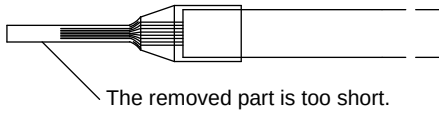
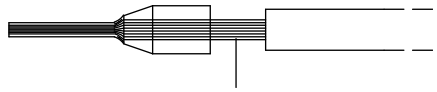
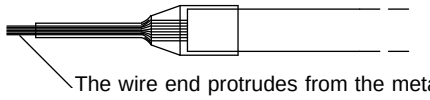
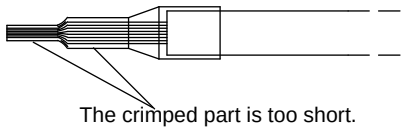
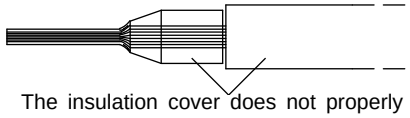
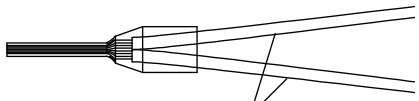
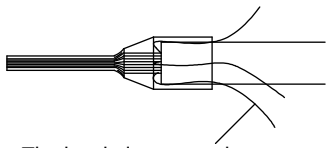


Processing is completed.

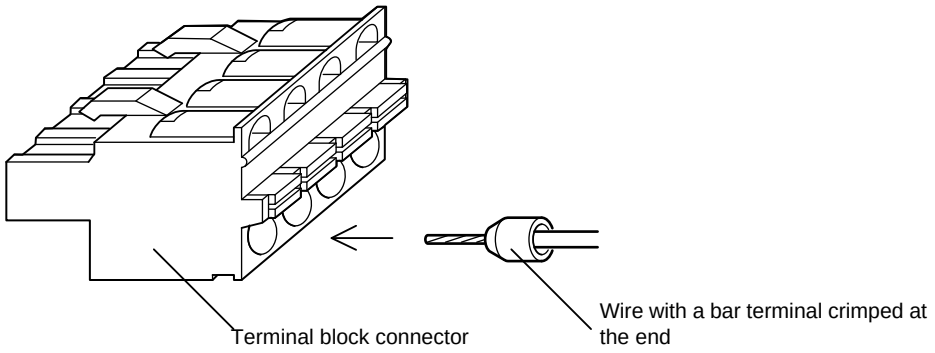
Proper example of processing wire end

Proper example


Improper example of processing wire end

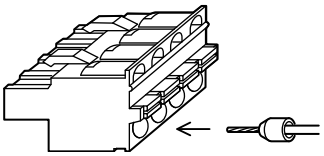
Improper example	Description
	It may cause the wire to come out of the bar terminal.
	It may cause short-circuit or an electrical shock.
	It may cause improper connection with the terminal block. The protruding length must be less than 0.5mm.
	It may cause the wire to come out of the bar terminal.
	It may cause short-circuit or an electrical shock.
	Avoid crimping two or more wire ends in a bar terminal. Doing so may cause a break of the wire, displacement of the cable or improper connection. For crimping two wires, use the 2-wire bar terminal. For such a case, ensure that the diameters are the same.
	It may cause short-circuit or an electrical shock.

Connecting bar terminal to terminal block connector

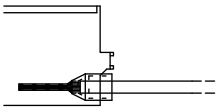


■ Wiring procedures

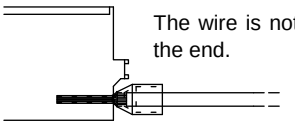
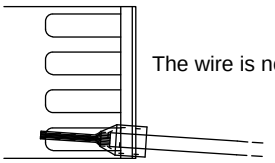
1. Insert the wire with bar terminal into the wire insertion slot.



2. Insert to the end firmly.

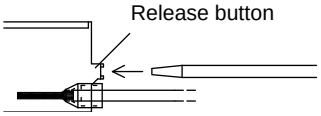


Improper example of wire connection

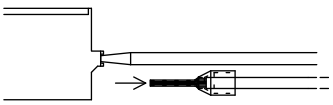
Improper example	Description
 The wire is not inserted to the end.	The wire may come out and cause short-circuit or an electric shock.
 The wire is not inserted straight.	It may not have been inserted to the depth of the connector.

■ Disconnection

1. Push the lock release button with a screwdriver or other tools.



2. Pull out the wire.



MEMO

Chapter 6
Appendix

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Accessories (sold separately)

Safety light curtain connection cable

■ Single-side connector cable for connection with safety light curtain

- The attached at one side of the cable is the connector for Model F3SN/F3SH/F3SJ series.
- Two different models are available for emitter and receiver.

Set model	For emitter		For receiver		Length (L, unit :mm)
Model F39-JC3A	Model F39-JC3A-L	Gray cable	Model F39-JC3A-D	Black cable	3000
Model F39-JC7A	Model F39-JC7A-L		Model F39-JC7A-D		7000
Model F39-JC10A	Model F39-JC10A-L		Model F39-JC10A-D		10000
Model F39-JC15A	Model F39-JC15A-L		Model F39-JC15A-D		15000

■ Double-side connector cable for connection with safety light curtain

- The attached at the both sides of the cable is the connector for Model F3SN/F3SH/F3SJ series.
- Two different models are available for emitter and receiver.
- The cable length should be limited by number of devices in serial connection. For the details, refer to Model F3SN/F3SH/F3SJ Instruction Manual.
- Maximum cable length to be used for serial connection is 3m.

Set model name	For emitter		For receiver		Length (L, unit :mm)
Model F39-JCR2B	Model F39-JCR2B-L	Grey cable	Model F39-JCR2B-D	Black cable	200
Model F39-JCR5B	Model F39-JCR5B-L		Model F39-JCR5B-D		500
Model F39-JC3B	Model F39-JC3B-L		Model F39-JC3B-D		3000
Model F39-JC5B (Note)	Model F39-JC5B-L		Model F39-JC5B-D		5000
Model F39-JC7B (Note)	Model F39-JC7B-L		Model F39-JC7B-D		7000
Model F39-JC10B (Note)	Model F39-JC10B-L		Model F39-JC10B-D		10000
Model F39-JC15B (Note)	Model F39-JC15B-L		Model F39-JC15B-D		15000
Model F39-JC20B (Note)	Model F39-JC20B-L		Model F39-JC20B-D		20000

(Note): Not for use in serial connection.

■ Branch connector for safety light curtains

Model	Connecting device
Model F39-CN5	Model F3SN/F3SH/F3SJ ↔ Model F3SX series

■ Double-end connector cable

Model	Cable length	Connecting device
Model F39-JC1T	1m	Model F39-CN5 ↔ Model F3SX series
Model F39-JC3T	3m	
Model F39-JC5T	5 m	
Model F39-JC10T	10 m	

Accessories for function set-up software for model F3SX

■ Function set-up software for model F3SX

Model name	Compatible OS
Model F3SX-CD□□□	Windows 98/2000/XP

■ Communication cable

• Cable to connect F3SX with a personal computer

Model name	Shape	Number of package
Model F39-JC2X1	D-SUB 9-pin socket	1

• Cable to connect F3SX with the programmable controller

Model name	Shape	Number of package
Model F39-JC2X2	D-SUB 9-pin plug	1

Recommended materials and tools

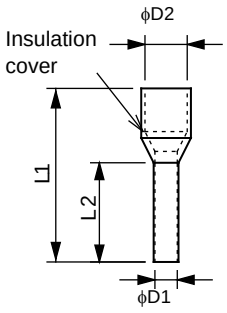
■ Bar terminal with plastic insulation collar

Use the ferrule with insulation cover (bar terminal) conforming to DIN46228-4 standard. The ferrule with similar appearance but not conforming to the standard, may not match the terminal block of this product.
(The dimensions regarding the wire are the rough standard. Confirm those beforehand.)
Note: Use wire of the same diameter for the two-wire bar terminals if any are used

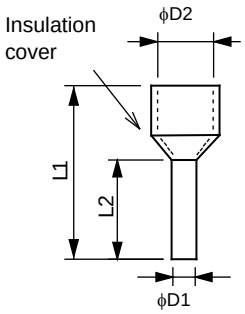
Specifications for reference (Product specifications of Phoenix Contact Japan)

Model of bar terminal		Wire dimensions		Bar terminal specifications					
		Section area of conductor(mm^2)	AWG	Removed length of insulation(mm)	Entire length L1(mm)	Length of metal part L2(mm)	Inner diameter of conductor D1 (mm)	Inner diameter of insulation cover D2 (mm)	Dimensions
1 For wire	AI 0.34-8TQ	0.34	22	10	12.5	8	0.8	2.0	*1
	AI 0.5-8WH	0.5	20	10	14	8	1.1	2.5	
	AI 0.75-8GY	0.75	18	10	14	8	1.3	2.8	
	AI 1.0-8RD	1.0	18	10	14	8	1.5	3.0	
	AI 1.5-8BK	1.5	16	10	14	8	1.8	3.4	
2 For wire	AI-TWIN 2 x 0.5-8WH	2 x 0.5	-	10	15	8	1.5	2.5/4.7	*2
	AI-TWIN 2 x 0.75-8GY	2 x 0.75	-	10	15	8	1.8	2.8/5.0	
	AI-TWIN 2 x 1-8RD	2 x 1	-	10	15	8	2.05	3.4/5.4	

* 1 For 1 wire



* 2 For 2 wires



■ Crimp tool specialized for bar terminal

Manufacturer	Model
Phoenix Contact	CRIMPFOX UD6

Communication Reference

Outline of communication functions

The communication function is to monitor the input/output state, etc., of F3SX using the program created on the host computer such as a personal computer or a programmable controller. Accordingly, the descriptions are made here for the function from the viewpoint of the host computer.

CompoWay/F is the unified communication procedures used in the OMRON versatile serial communication. Using CompoWay/F enables communication with the host computer to be simplified by the unified frame format and the set of commands conforming to the FINS*, of which validity has been proven in uses with the OMRON programmable controller or the similar products.

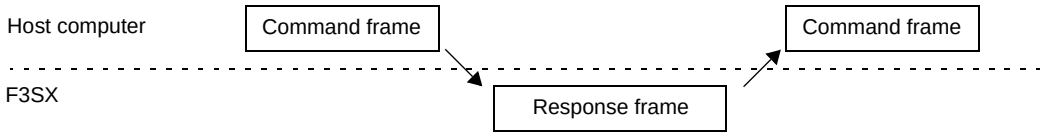
*FINS (Factory Interface Network Service) :
protocol to help message exchange among controllers on the OMRON FA Network.

■ Communication specifications

Connection of transmission channel	RS-232C : Point-to-point
Communication method	RS-232C
Synchronous fashion	Asynchronous method
Communication rate	9600bps
Transmission code	ASCII
Length of data bit	8 bit
Length of stop bit	1 bit
Error detection	BCC (Block check character)
Flow control	None
Interface	RS-232C
Re-try function	None
Communication buffer	149byte

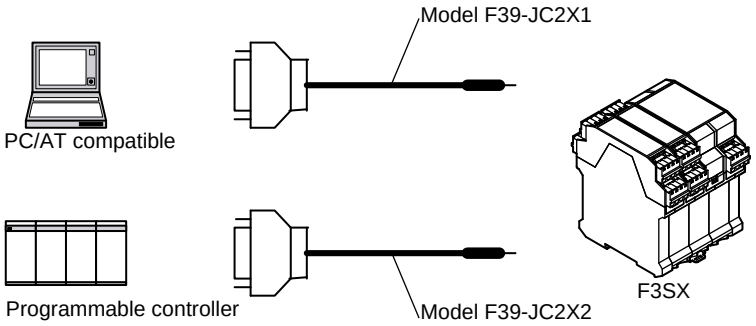
■ Transmission procedure

The host computer transmits a command frame, and F3SX transmits a response frame back to the host computer. There, a command frame is responded by a response frame in correspondence. The operation of the command frame and response frame can be illustrated as follows.



■ Wiring

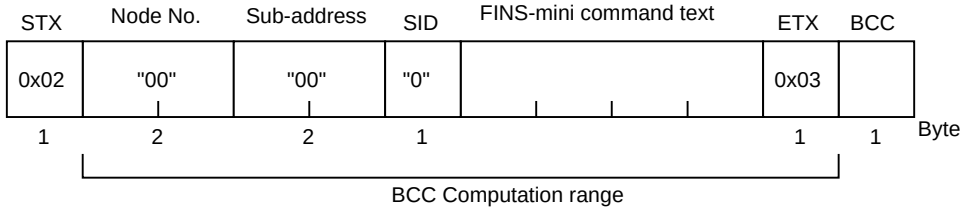
▪ Example of wiring



Communication procedure of CompoWay/F

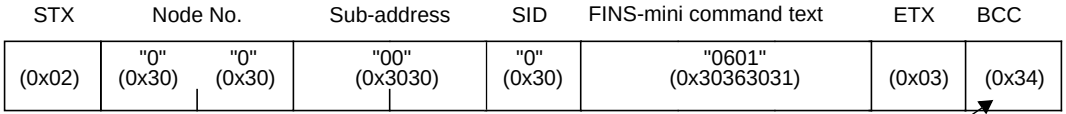
Hereinafter, with 0x attached before numeric figures, like (0x02), represents hexadecimal figures.
With " " represent ASCII characters.
Numeric figures under a segment of a frame represent a number in byte.

■ Command frame



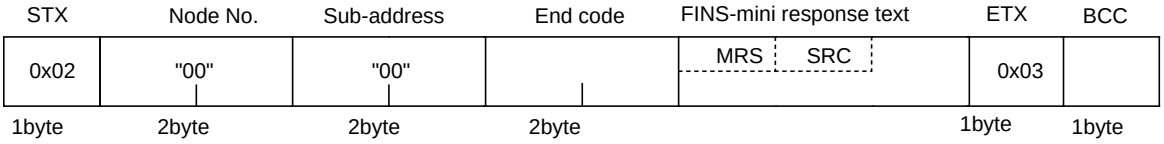
STX	Code to indicate the top of communication frame. Be sure to set this code for the top byte of (0x02). At the time of receiving STX again during reception, the reception will be re-tried from the received STX on.
Node No.	The machine number to specify the destination. By using the function set-up software for model F3SX (Model F3SX-CD□□□, sold separately), the machine number can be specified. * The machine number is set to “00” at the factory shipment.
Sub-address	Be sure to specify "00".
SID (service ID)	Be sure to specify "0".
FINS-mini command text	Main body of command.
ETX	Code to indicate the end of text. (0x03)
BCC	Block check character. Stores BCC computation results raging from Node No. to ETX.

BCC computation:BCC (Block check character) calculates exclusive-OR of the values for each 1byte from the node No. to ETX, and set the results at BCC.



BCC = 0x30 ≠ 0x30 ≠ 0x30 ≠ 0x30 ≠ 0x30 ≠ 0x30 ≠ 0x36 ≠ 0x30 ≠ 0x31 ≠ 0x03 = 0x34
≠ indicates XOR (Exclusive-OR) computation.

■ Response frame



Data name	Description
STX	Code to indicate the top of communication frame. This code is set for the top byte of (0x02).
Node No.	"00" is attached. *If you specified the machine number by using the function set-up software for model F3SX (Model F3SX-CD□□□□, sold separately), the specified number will be attached.
Sub-address	"00" is attached.
End code	Returns executed results against a command frame.
FINS-mini response text	Main body of response.
ETX	Code to indicate the end of text. (0x03)
BCC	Block check character. Stores BCC computation results raging from Node No. to ETX.

End code of a response is as follows.

End code	Name	Error	Priority of error detection
"00"	Normal end	The case that command processing ends normally.	None
"0F"	FINS command error	The case that specified FINS command cannot be executed.	6
"11"	Framing error	The case that stop bit of command frame character is [0].	1
"12"	Over-run error	The case that new data transmission is attempted when already filled with received data.	2
"13"	BCC error	The case that received BCC is not identical to the computed BCC.	4
"14"	Format error	The case that the character in FINS-mini command text is other than "0" to "9", "A" to "F", " " (space). The case that SID and FINS-mini command text do not exist, or else FINS-mini command text does not exist. The case that [MRC/SRC] of FINS-mini command text is missing.	5
"18"	Frame length error	The case that received frame exceeds given number of bytes.	3

- End code is returned in response to one command frame receipt addressed to own Node.
- No response returns when frame is not completed up to ETX, BCC characters.
- No response returns when sub-address is other than "00".
- Priority of error detection indicates the order of errors when multiple errors have occurred.

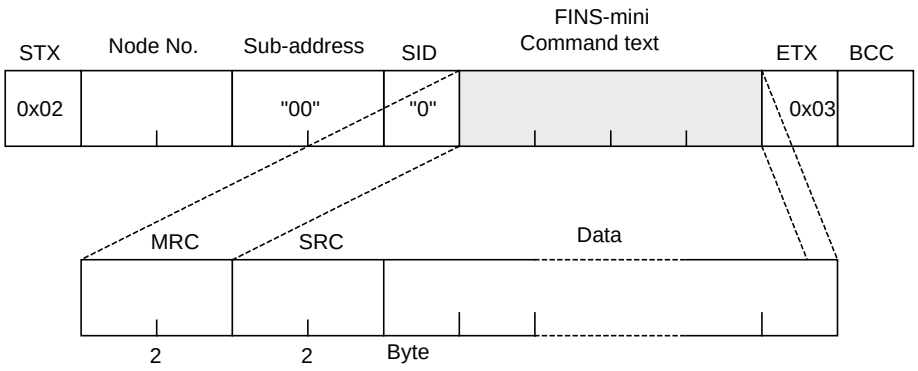
Note:It is affected by noises, etc., whether error response returns or no response returns. Ensure that re-try is made on the host computer side.

■ Command text

FINS-mini command text / FINS-mini response text is the main text of command / response. FINS-mini command text / FINS-mini response text is composed of the following data.

▪ Command

MRC (Main request code) and SRC (Sub-request code), and the necessary data thereafter, are added.



■ Example of end code

▪ When no command text is provided (i.e., the mahcine number is “00”)

• Command

STX	Node No.		Sub-address		SID	ETX	BCC
0x02	"0"	"0"	"0"	"0"	"0"	0x03	

• Response

STX	Node No.		Sub-address		End code		ETX	BCC
0x02	"0"	"0"	"0"	"0"	"1"	"4"	0x03	

▪ When node number is missing.

• Command

STX		ETX	BCC
0x02		0x03	

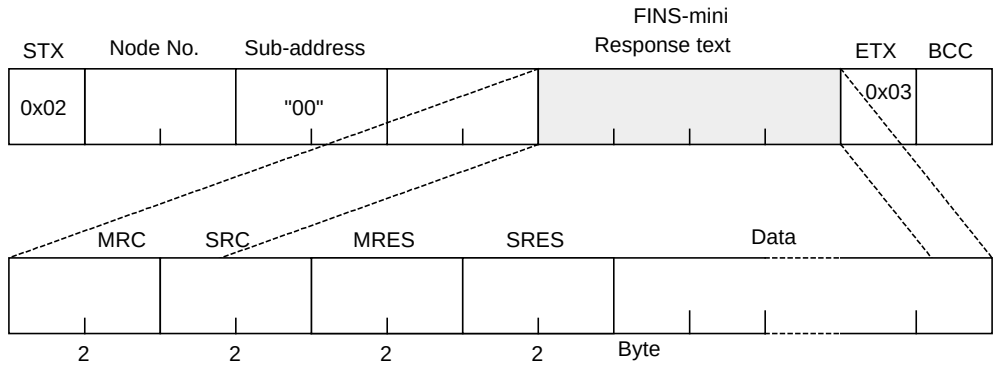
One character short for node number.

• Response

No response is provided.

▪ Response

After MRC/SRC, MRES (Main response code) and SRES (Sup-response code), and the necessary data thereafter, are added.



Only MRC/SRC, MRES/SRES are the response for the case that the specified FINS-mini command could not be executed.

Command reference

■ Listing of FINS-mini commands

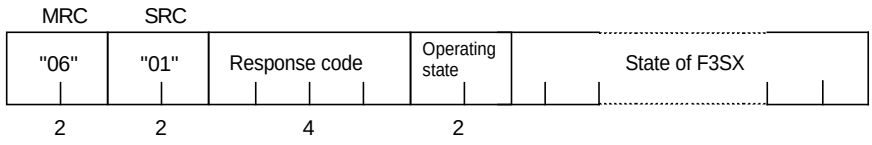
▪ MRC/SRC listing

Type of command	MRC	SRC	Error
Readout of F3SX status	"06"	"01"	Reads out F3SX operations (states of input/output, errors).
Echo back test	"08"	"01"	Executes echo back test.
Readout of parameter area	"02"	"01"	Reads out measurements in feedback monitoring time, energizing time, number of output switching frequency, error code, error logs and cross-channel synchronous monitoring time.

■ Readout of F3SX status

▪ Fins-mini command text

▪ Fins-mini response text



Response code

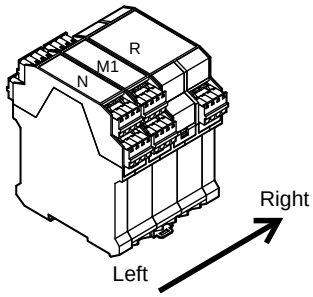
Response code	Error name	Description
"1001"	Excess command length	The command is too long.
"0000"	Normal end	-

Operating state

Code	Operating state
"00"	Normal operating
"10"	In lock-out state

State of F3SX

The data differs depending on the F3SX model. The data are arranged in order from the left to the right as viewed towards the F3SX front panel.



N (main module) data	M1 (input module) data	R (relay output module) data	...

N (main module) data :2byte

[2nd byte]

Bit	Contents of data	1	0
0	External indicator states	ON	OFF
1	(None)	-	(None)
2	AS1 output state	ON	OFF
3	AS2 output state	ON	OFF
4	AS3 output state	ON	OFF
5 6 7	Error messages (The bit alignment of error massage : bit 7, bit 6, bit 5)	000 :Normal 001 :Synchronization check error with emergency-stop input. 010 :Short-circuiting between emergency-stop inputs or error around internal circuit. 100 :Mis-wiring or wire break around Y1 to Y3 terminals. 101 :Error in external indicator, error around circuit. 111 :Other error (including error in other modules).	

[1st byte]

Bit	Contents of data	1	0
0	T12 input states	ON	OFF
1	T22 input states	ON	OFF
2	Y2 input states	ON	OFF
3	Y3 input states	ON	OFF
4	FB input states	ON	OFF
5	In interlock state	In interlock state	Normal state
6	Initiation command input states	ON	OFF
7	(None)	-	(None)

E (main module) data: 2 byte

[2nd byte]

Bit	Contents of data	1	0
0	SS1 output state	ON	OFF
1	SS2 output state	ON	OFF
2	AS1 output state	ON	OFF
3	AS2 output state	ON	OFF
4	AS3 output state	ON	OFF
5	Error messages (The bit alignment of error massage : bit 7, bit 6, bit 5)	000: Normal 001:Synchronization check error with emergency-stop input. 010 :Short-circuiting between emergency-stop inputs or error around internal circuit. 011: Mis-wiring at SS1/SS2 terminal / error in the internal circuits 100 :Mis-wiring or wire break around Y1 to Y3 terminals. 111 :Other error (including error in other modules).	
6			
7			

[1st byte]

Bit	Contents of data	1	0
0	T12 input states	ON	OFF
1	T22 input states	ON	OFF
2	Y2 input states	ON	OFF
3	Y3 input states	ON	OFF
4	FB input states	ON	OFF
5	In interlock state	In interlock state	Normal state
6	Initiation command input states	ON	OFF
7	(None)	-	(None)

R (relay output module) data :1byte

Bit	Contents of data	1	0
0	23-24 output states	ON	OFF
1	33-34 output states	ON	OFF
2	(None)	-	(None)
3	(None)	-	(None)
4	(None)	-	(None)
5	Error messages (The bit alignment of error massage : bit 7, bit 6, bit 5)	000 :Normal 001 :Error around relay or internal circuit. 111 :Other error (including error in other modules).	
6			
7			

M1 (mat input module) :2byte

[2nd byte]

Bit	Contents of data	1	0
0	T12 input states	ON	OFF
1	T22 input states	ON	OFF
2	(None)	-	(None)
3	(None)	-	(None)
4	T32 input states	ON	OFF
5	T42 input states	ON	OFF
6	(None)	-	(None)
7	(None)	-	(None)

* For mats, data of T12/T22 or T32/T42 should be "0" if a mat switch is activated.

[1st byte]

Bit	Contents of data	1	0
0	(None)	-	(None)
1	(None)	-	(None)
2	(None)	-	(None)
3	(None)	-	(None)
4	(None)	-	(None)
5	Error messages	000 :Normal 010: Breakage or circuit failure between T1-T2 100: Breakage or circuit failure between T3-T4 111: Other error (including other module's failure)	
6			
7			

L2 (light curtain input module) data : 1byte

Bit	Contents of data	1	0
0	Input states of control output 1 (terminals 1 to 8 side)	ON	OFF
1	Input states of control output 2 (terminals 1 to 8 side)	ON	OFF
2	Input states of control output 1 (terminals 9 to 16 side)	ON	OFF
3	Input states of control output 2 (terminals 9 to 16 side)	ON	OFF
4	(None)	-	(None)
5	Error messages (The bit alignment of error massage : bit 7, bit 6, bit 5)	000 :Normal 001 :Synchronization check error between control outputs (terminals 1 to 8 side). 010 :Error around input circuit of control output (terminals 1 to 8 side). 011 :Synchronization check error between control outputs (terminals 9 to 16 side). 100 :Error around input circuit of control output (terminals 9 to 16 side). 111 :Other error (including error in other modules).	
6			
7			

D1 (door switch input module) data : 2 bytes

[2nd byte]

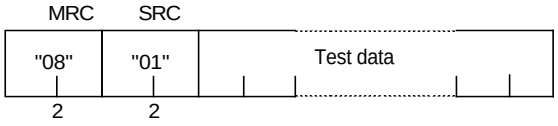
Bit	Contents of data	1	0
0	Terminal 5 input states	ON	OFF
1	Terminal 7 input states	ON	OFF
2	(None)	-	(None)
3	(None)	-	(None)
4	Terminal 12 input states	ON	OFF
5	Terminal 10 input states	ON	OFF
6	(None)	-	(None)
7	(None)	-	(None)

[1st byte]

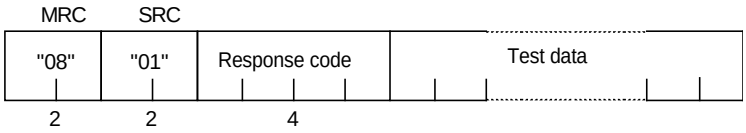
Bit	Contents of data	1	0
0	(None)	-	(None)
1	(None)	-	(None)
2	(None)	-	(None)
3	(None)	-	(None)
4	(None)	-	(None)
5	Error messages (The bit alignment of error massage : bit 7, bit 6, bit 5)	000 :Normal 001 :Synchronization check error between terminals 5-7. 010 :Short-circuiting between terminals 5-7 or error around circuit. 011 :Synchronization check error between terminals10-12. 100 :Short-circuiting between terminals10-12 or error around circuit. 111 :Other error (including error in other modules).	
6			
7			

■ Echo back test

▪ Fins-mini command text



▪ Fins-mini response text



Test data

Transmitted arbitrary test data will be sent back.

Response code

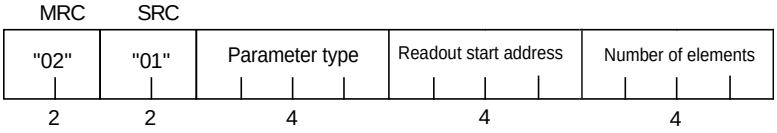
Response code	Error name	Description
"1001"	Excess command length	The command is too long.
"0000"	Normal end	-

Note:Maximum number of test data byte is 20byte. If a command with the test data in 21byte or more is sent, error will be responded.

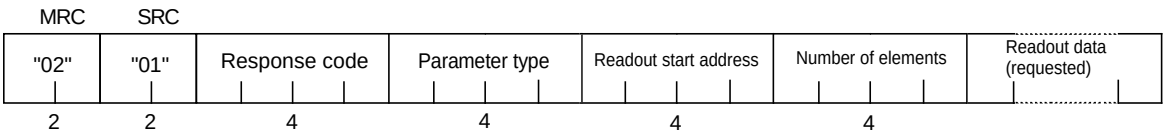
Note:ASCII characters to be used for test data are limited to " " (space), "0" to "9", and "A" to "F". If any ASCII characters other than these are used, the end code will become [14 : Format error].

■ Readout of parameter area

▪ Fins-mini command text



▪ Fins-mini response text



Data name	Description
Parameter type	The data of readout parameter type is attached.
Readout start address	The read start address is attached.
Number of elements	The read number of elements is attached.
Readout data	The data of readout parameter is attached. Access size of the data is byte.

Response code

Response code	Error name	Description
"1001"	Excess command length	The command is too long.
"1002"	Short of command length	The command is too short.
"1101"	Area type error	Wrong parameter type.
"1104"	Error outside of end address range	The specified end address (Start address plus number of elements) exceeds processing range.
"1100"	Parameter error	Wrong parameter setting (Type, address, number of elements).
"2203"	Operation error	Designated operation is not executed.
"0000"	Normal end	-

Parameter type listing

Parameter type code	Command name	Error
"4004"	Readout of feedback monitor time measurements (Safety output ON→OFF)	Reading the time length from when safety output turns OFF until feedback input turns ON.
"4005"	Readout of feedback monitor time measurements (Safety output OFF→ON)	Reading the time length from when safety output turns ON until feedback input turns OFF.
"4006"	Readout of energizing time	Reading the accumulated time length that F3SX power has been ON.
"4007"	Readout of number of output switching frequency	Reading accumulated number of frequency that safety output of F3SX has switched.
"4008"	Readout of error code	Reading error code in lock-out state.
"4009"	Readout of error log	Reading past error logs (Error code and the relevant energizing time at the time of occurrence).
"4010"	Readout of output-synchronized monitor time (main module)	Regarding the emergency-stop input section of the main module, the time length from when one part turns ON till the other turns ON is read out.
"4011"`"4014"	Readout of input-synchronized monitor time (Input module: Terminals 1 to 8)	Regarding the safety input section of input module, the time length from when one side turns ON till the other turns ON is read out.
"4021"- "4024"	Readout of input-synchronized monitor time (Input module: Terminals 9 to 16)	Regarding the safety input section of input module, the time length from when one side turns ON till the other turns ON is read out.

▪ Readout of feedback monitor time measurements (Safety output ON→OFF)

Items	Error
Error	Reading the time length from when safety output turns OFF until feedback input turns ON.
Type code	"4004"
Number of data	2byte x 16 for each 1 data = Max. 32byte (Past 16 data can be read.)

Readout start address	Contents of data
"0000"	Latest feedback monitor time measurements.
"0001"	The feedback monitor time measurements 2 times before the latest.
"0002"	The feedback monitor time measurements 3 times before the latest.
•	•
•	•
"000F"	The feedback monitor time measurements 16 times before the latest.

Example of command

(1) Reading out the latest feedback monitor time measurements.

• Command

STX	CompoWay/F header	MRC	SRC	Type code	Address	Number of elements	ETX	BCC
0x02	"00000"	"02"	"01"	"4004"	"0000"	"8002"	0x03	

• Response

STX	CompoWay/F header	MRC	SRC	Response code	Type code	Address	Number of elements	Data	ETX	BCC
0x02	"000000"	"02"	"01"	"0000"	"4004"	"0000"	"8002"	"001A"	0x03	

→The read data is “001A” = 26 (ms).

(2) Reading out the last 3 feedback monitor time measurements.

• Command

STX	CompoWay/F header	MRC	SRC	Type code	Address	Number of elements	ETX	BCC
0x02	"00000"	"02"	"01"	"4004"	"0000"	"8006"	0x03	

• Response

STX	CompoWay/F header	MRC	SRC	Response code	Type code	Address	Number of elements	Data	ETX	BCC
0x02	"000000"	"02"	"01"	"0000"	"4004"	"0000"	"8006"	"001A00150017"	0x03	

→The read data is “001A00150017” = Latest measurements is 26 (ms), measurements 2 times before the latest is 21 (ms), and 3 measurements before the latest is 23 (ms).

(3) Reading out the feedback monitor time measurement 7 times before the latest.

• Command

STX	CompoWay/F header	MRC	SRC	Type code	Address	Number of elements	ETX	BCC
0x02	"00000"	"02"	"01"	"4004"	"0006"	"8002"	0x03	

• Response

STX	CompoWay/F header	MRC	SRC	Response code	Type code	Address	Number of elements	Data	ETX	BCC
0x02	"000000"	"02"	"01"	"0000"	"4004"	"0006"	"8002"	"0105"	0x03	

→The read data is “0105” = 261 (ms).

Note: Logs are held during the time when the power is ON. If the power is turned OFF or the system reset is activated, the prior data storage should be cleared of.

Note:If the address is in the range other than "0000" to "000F", the response should be [Parameter error : 1100]

Note: This command is accepted only when the safety output is OFF. The response when safety output is ON should be [Operating error : 2203].

▪ Readout of feedback monitor time measurements (Safety output OFF→ON)

Items	Error
Error	Reading the time length from when safety output turns ON until feedback input turns OFF.
Type code	"4005"
Number of data	2byte x 16 for each 1 data = Max. 32byte (Past 16 data can be read.)

Readout start address	Contents of data
"0000"	Latest feedback monitor time measurements.
"0001"	The feedback monitor time measurements 2 times before the latest.
"0002"	The feedback monitor time measurements 3 times before the latest.
•	•
•	•
"000F"	The feedback monitor time measurements 16 times before the latest.

Example of command

(1) Reading out the latest feedback monitor time measurements.

• Command

STX	CompoWay/F header	MRC	SRC	Types Code	Address	Number of elements	ETX	BCC
0x02	"00000"	"02"	"01"	"4005"	"0000"	"8002"	0x03	

• Response

STX	CompoWay/F header	MRC	SRC	Response code	Type code	Address	Number of elements	Data	ETX	BCC
0x02	"000000"	"02"	"01"	"0000"	"4005"	"0000"	"8002"	"001A"	0x03	

→The read data is “001A” = 26 (ms).

(2) Reading out the last 3 feedback monitor time measurements.

• Command

STX	CompoWay/F header	MRC	SRC	Type code	Address	Number of elements	ETX	BCC
0x02	"00000"	"02"	"01"	"4005"	"0000"	"8006"	0x03	

• Response

STX	CompoWay/F header	MRC	SRC	Response code	Type code	Address	Number of elements	Data	ETX	BCC
0x02	"000000"	"02"	"01"	"0000"	"4005"	"0000"	"8006"	"001A00150017"	0x03	

→The read data is “001A00150017” = Latest measurements is 26 (ms), measurements 2 times before the latest is 21 (ms), and 3 measurements before the latest is 23 (ms).

(3) Reading out the feedback monitor time measurement 7 times before the latest.

• Command

STX	CompoWay/F header	MRC	SRC	Type code	Address	Number of elements	ETX	BCC
0x02	"00000"	"02"	"01"	"4005"	"0006"	"8002"	0x03	

• Response

STX	CompoWay/F header	MRC	SRC	Response code	Type code	Address	Number of elements	Data	ETX	BCC
0x02	"000000"	"02"	"01"	"0000"	"4005"	"0006"	"8002"	"0105"	0x03	

→The read data is “0105” = 261 (ms).

Note:The history can be stored only during the power is ON. If the power is turned OFF, the prior data storage should be cleared of.

Note:If the address is in the range other than "0000" to "000F", the response should be [Parameter error : 1100]

Note:This command is accepted only when the safety output is OFF. The response when safety output is ON should be [Operating error : 2203].

▪ Readout of energizing time

Items	Error
Error	Reading the accumulated time length that F3SX power has been ON.
Type code	"4006"
Data volume	4byte

Readout start address	Contents of data
“0000” (fixed)	Accumulated time length that F3SX power has been ON.

Example of command

Reading out the accumulated time length that the F3SX power has been ON.

• Command

STX	CompoWay/F header	MRC	SRC	Type code	Address	Number of elements	ETX	BCC
0x02	"00000"	"02"	"01"	"4006"	"0000"	"8004"	0x03	

• Response

STX	CompoWay/F header	MRC	SRC	Response code	Type code	Address	Number of elements	Data	ETX	BCC
0x02	"000000"	"02"	"01"	"0000"	"4006"	"0000"	"8004"	"001055FB"	0x03	

→The read data is “001055FB” = 1070587 (minnutes).

Note:The data is stored in the F3SX’s EEPROM every 15 minutes. Accordingly, readout value after the power is re-turned ON may be less than that obtained before the re-turning.

Note:If the address is other than “0000”, the response should be [Parameter error : 1100].

▪ Readout of number of output switching frequency

Items	Error
Error	Reading the accumulated number of safety output switching frequency.
Type code	"4007"
Data volume	4byte

Readout start address	Contents of data
“0000” (fixed)	Accumulated number of F3SX output switching frequency.

Example of command

Reading out the accumulated number of F3SX output switching frequency.

• Command

STX	CompoWay/F header	MRC	SRC	Type code	Address	Number of elements	ETX	BCC
0x02	"00000"	"02"	"01"	"4007"	"0000"	"8004"	0x03	

• Response

STX	CompoWay/F header	MRC	SRC	Response code	Type code	Address	Number of elements	Data	ETX	BCC
0x02	"000000"	"02"	"01"	"0000"	"4007"	"0000"	"8004"	"00012345"	0x03	

→The read data is “00012345” = 74565 (times).

Note:The data is stored in the F3SX’s EEPROM every 15 minutes. Accordingly, readout value after the power is re-turned ON may be less than that obtained before the re-turning.

Note:If the address is other than “0000”, the response should be [Parameter error : 1100].

▪ Readout of error code

Items	Error
Error	Reading the error code of F3SX.
Type code	"4008"
Data volume	2byte

Readout start address	Contents of data
“0000” (fixed)	Error code of F3SX

Example of command

Reading out the error code of F3SX.

• Command

STX	CompoWay/F header	MRC	SRC	Type code	Address	Number of elements	ETX	BCC
0x02	"00000"	"02"	"01"	"4008"	"0000"	"8002"	0x03	

• Response

STX	CompoWay/F header	MRC	SRC	Response code	Type code	Address	Number of elements	Data	ETX	BCC
0x02	"000000"	"02"	"01"	"0000"	"4008"	"0000"	"8002"	"2001"	0x03	

→The read data is “2001”: Wiring error in the reset input.

Note:If the F3SX transmits this command during normal operation, the response data should be "0000".

Note:If the address is other than “0000”, the response should be [Parameter error : 1100].

Note: For the correspondence of error code with error contents, see “Troubleshooting”.

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▪ Readout of error log

Items	Error
Error	Reading the error code of F3SX. The past 10 of data can be read including the latest.
Type code	"4009"
Contents of data	Error code (2byte) + energizing time at error occurring (4byte) = 6byte in total (= 8006 elements)
Data volume	6byte per 1 data x 10 (able to read out data for the last 10 logs) = Max. 60 byte.

Readout start address	Contents of data
"0000"	The latest error log.
"0001"	The error logs 2 time before the latest.
"0002"	The error logs 3 time before the latest.
•	•
•	•
"0009"	The error logs 10 time before the latest.

Example of command

(1) Reading out the latest error log.

• Command

STX	CompoWay/F header	MRC	SRC	Type code	Address	Number of elements	ETX	BCC
0x02	"00000"	"02"	"01"	"4009"	"0000"	"8006"	0x03	

• Response

STX	CompoWay/F header	MRC	SRC	Response code	Type code	Address	Number of elements	Data	ETX	BCC
0x02	"000000"	"02"	"01"	"0000"	"4009"	"0000"	"8006"	"230100105A3B"	0x03	

→The read data is “230100105A3B” = Error code 2301 : Short-circuiting or mis-wiring around emergency-stop input, the energizing time is 1071675 minutes.

(2) Reading out the 2 last error log data.

• Command

STX	CompoWay/F header	MRC	SRC	Type code	Address	Number of elements	ETX	BCC
0x02	"00000"	"02"	"01"	"4009"	"0000"	"800C"	0x03	

• Response

STX	CompoWay/F header	MRC	SRC	Response code	Type code	Address	Number of elements	Data	ETX	BCC
0x02	"000000"	"02"	"01"	"0000"	"4009"	"0000"	"800C"	"230100010506390300009 2A3"	0x03	

→the read data is “230100010506390300009 2A3” =

The latest error code 2301 : Short-circuiting or mis-wiring around emergency-stop input, the energizing time is 66822 minutes.

2 error codes before the latest 3903 : Wire break or error in external indicator, the energizing time is 37539 minutes.

(3) Reading out the error log data 7 times before the latest.

• Command

STX	CompoWay/F header	MRC	SRC	Type code	Address	Number of elements	ETX	BCC
0x02	"00000"	"02"	"01"	"4009"	"0006"	"8006"	0x03	

• Response

STX	CompoWay/F header	MRC	SRC	Response code	Type code	Address	Number of elements	Data	ETX	BCC
0x02	"000000"	"02"	"01"	"0000"	"4009"	"0006"	"8006"	"270100550361"	0x03	

→The read data is “270100550361” = Error code 2701 : Error around the circuit in F3SX, the energizing time is 5571425 minutes.

Note:If the address is in the range other than "0000" to "0009", the response should be [Parameter error : 1100].
Note: For the correspondence of error code with error contents, see “Troubleshooting”.

Troubleshooting p.6-25

Note:This command is accepted only when safety output is OFF. The response when safety output is ON should be [Operating error : 2203].

▪ Readout of cross-channel synchronous monitor time (Main Module)

Items	Error
Error	Regarding the emergency-stop input section of the main module, the time length from when one side turns ON till the other turns ON (time difference between T12 and T22 turn ON) is read out.
Type code	"4010"
Data volume	2byte x 16 for each 1 data = Max. 32byte (Past 16 data can be read.)

Readout start address	Contents of data
"0000"	The latest measurements of cross-channel synchronous monitor time at the emergency-stop input
"0001"	Measurements two times before the last of cross-channel synchronous monitor time at the emergency-stop input
"0002"	Measurements three times before the last of cross-channel synchronous monitor time at the emergency-stop input
•	•
•	•
"000F"	Measurements 16 times before the last of cross-channel synchronous monitor time at the emergency-stop input

Example of command

(1) Reading the latest cross-channel synchronous monitor time at the emergency-stop input.

• Command

STX	CompoWay/F header	MRC	SRC	Type code	Address	Number of elements	ETX	BCC
0x02	"00000"	"02"	"01"	"4010"	"0000"	"8002"	0x03	

→Read the latest cross-channel synchronous monitor time at the emergency-stop input.

• Response

STX	CompoWay/F header	MRC	SRC	Response code	Type code	Address	Number of elements	Data	ETX	BCC
0x02	"000000"	"02"	"01"	"0000"	"4010"	"0000"	"8002"	"0014"	0x03	

→The read data is 0014 = 20(ms).

(2) Reading the data 3 times before the latest of cross-channel synchronous monitor time at the emergency-stop input.

• Command

STX	CompoWay/F header	MRC	SRC	Type code	Address	Number of elements	ETX	BCC
0x02	"00000"	"02"	"01"	"4010"	"0000"	"8006"	0x03	

→Read the past three cross-channel synchronous time measurements at the emergency-stop input.

• Response

STX	CompoWay/F header	MRC	SRC	Response code	Type code	Address	Number of elements	Data	ETX	BCC
0x02	"000000"	"02"	"01"	"0000"	"4010"	"0000"	"8006"	"0014" "001A" "0017"	0x03	

→The read data is 0014001A0017 = the latest is 20(ms), two times before the latest is 26(ms), and three times before the latest is 23(ms).

(3) Reading the data 7 times before the latest of cross-channel synchronous monitor time at the emergency-stop input.

• Command

STX	CompoWay/F header	MRC	SRC	Type code	Address	Number of elements	ETX	BCC
0x02	"00000"	"02"	"01"	"4010"	"0006"	"8002"	0x03	

→Read seven times before the last cross-channel synchronous monitor time at the emergency-stop input.

• Response

STX	CompoWay/F header	MRC	SRC	Response code	Type code	Address	Number of elements	Data	ETX	BCC
0x02	"000000"	"02"	"01"	"0000"	"4010"	"0006"	"8002"	"00C8"	0x03	

→The read data is 00C8 = 200(ms).

Note: The history is stored only during the power is ON. If the power is turned OFF or the system reset is activated, the prior data storage should be cleared.

Note: If the address is other than 0000 to 000F, the response should be [Parameter error : 1100].

Note: This command is accepted only when the safety output is OFF. The response when safety output is ON should be [Operating error : 2203].

Note: The maximum measurement time for the time difference is 59990ms.

▪ Readout of cross-channel synchronous monitor time (Input Module)

<Terminals 1 to 8>

Items	Error
Error	Regarding the safety input section of the input module (terminals 1 to 8), the time length from when one side turns ON till the other turns ON is read out.
Type code	"4011"-"4014"
Data volume	2byte x 16 for each 1 data = Max. 32byte (Past 16 data can be read.)

<Terminals 9 to 16>

Items	Error
Error	Regarding the safety input section of the input module (terminals 9 to 16), the time length from when one side turns ON till the other turns ON is read out.
Type code	"4021"`"4024"
Data volume	2byte x 16 for each 1 data = Max. 32byte (Past 16 data can be read.)

Readout start address	Contents of data
"0000"	The latest measurements of cross-channel synchronous monitor time at the safety input
"0001"	The data of measurements two times before the latest cross-channel synchronous monitor time at the safety input
"0002"	The data of measurements three times before the latest cross-channel synchronous monitor time at the safety input
•	•
•	•
"000F"	The data of measurements 16 times before the latest cross-channel synchronous monitor time at the safety input

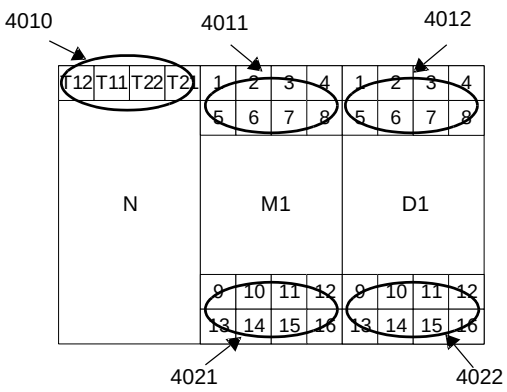
Regarding type code

Specify the safety switch (safety input section) to read out cross-channel synchronous monitor time by the type code.

The least significant digit: Module position
[1], to the right of the main module
[2], two to the right of the main module
•
•
[4], four to the right of the main module

The second to the least significant digit:
[1] terminals 1 to 8 side
[2] terminals 9 to 16 side

F3SX-N-M1D1



Example of command (for the case of abovementioned F3SX-N-M1D1)

(1) Reading out cross-channel synchronous monitor time at the M1 module terminals 1 to 8 (Safety mat).

• Command

STX	CompoWay/F header	MRC	SRC	Type code	Address	Number of elements	ETX	BCC
0x02	"00000"	"02"	"01"	"4011"	"0000"	"8002"	0x03	

→Read the latest cross-channel synchronous monitor time at the emergency-stop input.

• Response

STX	CompoWay/F header	MRC	SRC	Response code	Type code	Address	Number of elements	Data	ETX	BCC
0x02	"000000"	"02"	"01"	"0000"	"4011"	"0000"	"8002"	"001A"	0x03	

The read data is 007D = 125(ms).

(2) Reading the last three data of cross-channel synchronous monitor time at the D1 module terminals 9 to 16 side (ex. limit switch).

• Command

STX	CompoWay/F header	MRC	SRC	Type code	Address	Number of elements	ETX	BCC
0x02	"00000"	"02"	"01"	"4022"	"0000"	"8006"	0x03	

→Read three times before the latst cross-channel synchronous monitor time at the emergency-stop input.

• Response

STX	CompoWay/F header	MRC	SRC	Response code	Type code	Address	Number of elements	Data	ETX	BCC
0x02	"000000"	"02"	"01"	"0000"	"4022"	"0000"	"8006"	"0014" "001A" "0017"	0x03	

→The read data is 0014001A0017 = the latest is 20(ms), two times before the latest is 26(ms), and three times before the latest is 23(ms).

(3) Reading the data 7 times before the latest cross-channel synchronous monitor time at the D1 module terminals 1 to 8 side (ex. Limit switch).

• Command

STX	CompoWay/F header	MRC	SRC	Type code	Address	Number of elements	ETX	BCC
0x02	"00000"	"02"	"01"	"4012"	"0006"	"8002"	0x03	

→Read seven times before the last cross-channel synchronous monitor time at the emergency-stop input.

• Response

STX	CompoWay/F header	MRC	SRC	Response code	Type code	Address	Number of elements	Data	ETX	BCC
0x02	"000000"	"02"	"01"	"0000"	"4012"	"0006"	"8002"	"00C8"	0x03	

→The read data is 00C8 = 200(ms).

Note: The history is stored only during the power is ON. If the power is turned OFF or the system reset is activated, the prior data storage should be cleared.

Note: If the address is other than 0000 to 000F, the response should be [Parameter error : 1100].

Note: This command is accepted only when the safety output is OFF. The response when safety output is ON should be [Operating error : 2203].

Note: When read out for the output module, the response should be [Parameter error: 1100].

Troubleshooting

Error code and measures to be taken

Every time when F3SX enters into lock-out state, the error code is recorded. The error codes can be read out through communication. Take appropriate measures according to the table below.
(For the details of communication commands, see “Communication Reference”.)

Communication Reference p.6-5

Code	Error	Assumed causes	Example of measures
0000	In operation with no error.	-	-
01XX to 0CXX	Error around F3SX internal circuit.	Affected by noises excess level.	Confirm noise environment surrounding F3SX.
		Trouble with F3SX internal circuit.	Replace F3SX.
2001	Initial wiring error around reset input terminal.	Improper wiring with reset input terminal.	Confirm that wiring is suitable for auto reset or manual reset.
2002	Wiring error around reset input terminal.	Wire break or short-circuit around reset input terminal.	Confirm that wiring is suitable for auto reset or manual reset.
2003	Error around reset input circuit.	Affected by noises excess level.	Confirm noise environment surrounding F3SX.
		Trouble with internal circuit related to reset input terminal.	Replace F3SX.
21xx	Error around F3SX internal circuit.	Affected by noises excess level.	Confirm noise environment surrounding F3SX.
		Trouble with F3SX internal circuit.	Replace F3SX.
22xx	Error around F3SX internal circuit.	Affected by noises excess level.	Confirm noise environment surrounding F3SX.
		Trouble with F3SX internal circuit.	Replace F3SX.
2301	Short-circuit among inputs of emergency-stop switch.	Short-circuiting around emergency-stop switch wiring.	Confirm wiring of emergency-stop switches.
240X	Short-circuit or wiring error around safety input (terminals 1 to 8 side).	Short-circuiting in wiring of input device connected to input module.	Confirm wiring of input device connected to input module.
242X	Short-circuit or wiring error around safety input (terminals 9 to 16 side).	Short-circuiting in wiring of input device connected to input module.	Confirm wiring of input device connected to input module.
25XX to 28XX	Error around F3SX internal circuit.	Affected by noises excess level.	Confirm noise environment surrounding F3SX.
		Trouble with F3SX internal circuit.	Replace F3SX.
2901 2B01 2B02 2D01	Trouble with DC solid-state safety output (E module only)	Short-circuiting between SS1 and SS2 terminals or mis-wiring of SS1 or SS2 terminal.	Check the wiring between SS1 and SS2 terminals.
		Trouble with SS1 or SS2 terminal internal circuit.	Replace F3SX.
2AXX 2CXX 2EXX to 36XX	Error around F3SX internal circuit.	Affected by noises excess level.	Confirm noise environment surrounding F3SX.
		Trouble with F3SX internal circuit.	Replace F3SX.
3801	Initial wiring error around feedback input.	Improper wiring with external device such as contactor.	Confirm wiring with external device such as contactor. Wiring for reset inputs p.2-28

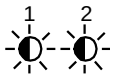
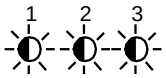
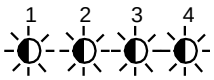
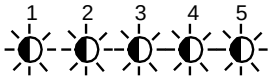
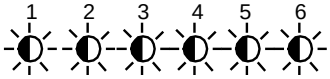
Code	Error	Assumed causes	Example of measures
3802	Time-out in feedback input monitoring.	Trouble occurs with any of the external devices such as contactor.	Replace the external device.
		Short-circuiting or wire break around relay contacts or feedback input terminal.	Confirm the wiring with relay contacts or feedback input terminal.
3803	Wiring error around feedback input.	Short-circuiting or wire break around relay contacts or feedback input terminal.	Confirm the wiring with relay contacts or feedback input terminal.
3901	Error around external indicator output circuit (EL2).	Affected by noises excess level.	Confirm noise environment surrounding F3SX.
		Trouble with internal circuit in of external indicator output terminal.	Replace F3SX.
3902	Error around external indicator output circuit (EL1).	Affected by noises excess level.	Confirm noise environment surrounding F3SX.
		Trouble with internal circuit in of external indicator output terminal.	Replace F3SX.
3903	Wiring error around external indicator output, or error in external indicator.	Wire break in connection with external indicator.	Confirm wiring with external indicator.
		The external indicator is defective.	Replace external indicator.
3AXX	Error in F3SX internal circuits	Affected by excess level of noises	Check noise circumstances.
		Troubles in F3SX internal circuits	Replace F3SX.
4001 4002 4003	Errors in log data.	History data of energizing time and output switching frequency and error log have been initialized by noises, etc.	(It means that the history has been initialized. The F3SX performance is not affected.)
5001	Error around F3SX internal circuit.	Affected by noises excess level.	Confirm noise environment surrounding F3SX.
		Trouble with F3SX internal circuit.	Replace F3SX.

Note: The least significant digit of the error code 240X / 242X / 270X denotes the module position. The input module positions are denoted in the manner 1, 2, ... in the order from the main module side.

Error indications and measures to be taken

When F3SX detects an error, indicator of ER lights up, or flashes to notify the error contents.
Take appropriate measures according to the table below.

■ Main module

ER indication	Error	Assumed causes	Measures to be taken
● Lighting up	Synchronization error of emergency-stop switch inputs.	Defects in emergency-stop switch contacts. Or improper wiring with emergency-stop switch.	Confirm emergency-stop switch or its wiring.
1-time flashing	Short-circuiting or wiring error among emergency- stop switch inputs.	Short-circuiting around emergency-stop switch wiring.	Confirm wiring with emergency-stop switch.
 2-time flashing	Error around circuit of emergency-stop switch terminal.	Trouble with emergency-stop switch input circuit.	Replace F3SX.
		Affected by noises of excess level.	Confirm noise environment surrounding F3SX.
 3-time flashing	Error around reset input terminal.	Improper wiring with reset input terminal.	Confirm wiring with reset input terminal.
		Short-circuiting or wire break around reset input terminal.	Confirm wiring with reset input terminal.
		Trouble with reset input terminal circuit.	Replace F3SX.
 4-time flashing:	Error around the external indicator output terminals (N module).	Trouble with external indicator.	Replace external indicator.
		Improper wiring with external indicator.	Confirm wiring with external indicator.
		Error around output circuit of external indicator.	Replace F3SX.
	Error around the DC solid-state safety output terminals (E module).	Trouble with the load (external devices).	Replace the external device.
		Improper wiring with external device such as contactor.	Confirm wiring with external device such as contactor.
		Trouble with DC solid-state safety output circuit	Replace F3SX.
 5-time flashing (Note 1)	Error around relay output terminal.	Trouble with relay output.	Replace F3SX.
		Affected by noises of excess level.	Confirm noise environment surrounding F3SX.
 6-time flashing	Error around feedback input terminal.	Improper wiring with external device such as contactor.	Confirm wiring with external device such as contactor.
		Trouble with external device such as contactor.	Replace the external device such as contactor.
Continuously flashing	Disturbance by noises or trouble with F3SX.	Affected by noises of excess level.	Confirm noise environment surrounding F3SX.
		Trouble with F3SX internal circuit.	Replace F3SX.

(Note 1)The product without assembled relay output module does not suffer from this kind of error.

■ M1 / L2 / D1 module

ER1 indication represents error occurring in the Ch.1, while ER2 indication represents error occurring in the Ch.2 side.

ER1/ER2 indication	Error	Assumed causes	Measures to be taken
● Lighting up	Synchronization error around inputs of input device.	Defects in input device contacts. Or improper wiring with input device.	Confirm input device or its wiring.
1 ☀ 1-time flashing	Short-circuiting or wiring error among input device.	Short-circuiting around input device.	Confirm wiring with input device.
1 2 ☀ ☀ 2-time flashing	Error around input terminal circuit of input device.	Affected by noises of excess level.	Confirm noise environment surrounding F3SX.
		Trouble with input circuit of input device.	Replace F3SX.

Check List for Installation and Wiring

(1) Confirm the followings after installation and wiring are finished.

Items to be confirmed for installation conditions	Confirmed
The machine is not in such a structure that bothers the safety functions such as enforced stop.	
The interlock reset switch is installed at the location where the entire danger area is viewed and an access cannot be made for an operation from the danger area.	
The response time of this F3SX matches that of the safety related system of the application system.	
Has been installed in the enclosure with degree of protection IP54.	
Has been fixed on the DIN rail with the fixture to prevent dropout of the main body.	
Spaces of 50mm each are given above and beneath the module, and 5mm or more each of the right and left. Placing into control board p.5-4	

(2) Confirm the followings before turning power ON.

Items to be confirmed for installation conditions	Confirmed
The power supply unit is used exclusively for F3SX and the safety devices of the light curtain, etc., to be connected with F3SX. In case that a power supply unit is connected to multiple devices, an allowance is given to the capacity for the total current value. There is no reverse connection with regard to the power supply.	
The power supply unit is for the 24V DC power complying with the EMC Directive, Low Voltage Directive and the output conservation specifications.	
In case that stranded wire is used, the processing of the wire end has been made by using a proper bar terminal complying with DIN46228-4 standard and the matching crimping tool.	
Double or reinforced insulation is provided between the 24V DC circuit of input/output and the output, and other parts on which the dangerous voltage should be applied.	
Wiring is separated between the safety channels and other channels.	
Output line is not short-circuited to 24V DC.	
No load is short-circuited to 24V DC.	

Maintenance Services and Inspection

The following describes maintenance services and inspection.

⚠WARNING	
For the inspection and/or maintenance of the F3SX, a “Responsible Person“ must confirm that the work has been properly performed.	
In order to maintain the safety functions, put the product in the state of output-off (the emergency-stop state) once every 24 hours.	

- As a safety measure, enter and keep the inspection results in the records.
- The person who is familiar with F3SX and the application system should perform an inspection.
- When the system is used and operated by persons different from those who designed and installed it, ensure that the users and operators are provided with thorough training regarding the maintenance services and inspection.
- Confirm at the daily inspection that the emergency-stop switch operates normally and effectively.
- Confirm at the daily inspection that the input devices operate normally and effectively.
- Give an inspection every six months to prevent short-circuiting or wire break that might be caused by loosened connectors or wiring.

Precautions concerning trial operation after changing function setup

The following describes the precautions to be noted when using the function setup software for model F3SX (Model F3SX-CD□□□, sold separately) to change the set-up of the safety-related functions of F3SX. For the details, confirm with HELP of Model F3SX-CD□□□.

■ Access rights

You will be prompted to enter a valid password before being able to begin changing the function setup.
(Note)
*The password set at the factory is “F3SX.”
*The “Responsible Person” must take the utmost care so that the password will not be known to those other than the “Responsible Person”.
*The password shall be entered required when making any modification, regardless of the safety functions to be modified.
(Recommendations)
It is strongly recommended that you change the password “F3SX” to a new one.
To change the password, select “File (F)” in the menu bar→ and then “Set Password (P).”

■ Function test

After setup change by using the function set-up software for model F3SX, a “Responsible Person” must confirm the proper function operations to approve the change. The functions that require operation check after changing their settings are as follows.
(Example of test procedure)

Functions	Setting	What to check	Date/name of personnel	Approval
ON-delay time	Module Time: ms	Does the output go on after the elapse of the specified time?	XXXX/YY/ZZ	XXXX/YY/ZZ
OFF-delay time	Module: ___ Time: ___ms	Does the output go off after the elapse of the time you specified?	XXXX/YY/ZZ	XXXX/YY/ZZ
Cross-channel synchronous monitoring time	Module Time: ___ms	(1) Does F3SX determine that the input is on if the cross-channel input is turned on within the time you specified? (ex. The ER indicator lights off, and the D1/D2 indicator lights on.) (2) Does F3SX determine that the input is off if the time that elapses from when the input of one side of the cross-channel goes on until when the input of the other side of the cross-channel goes on is more than the time you specified? (ex. Both the ER indicator and the D1/D2 indicator light on.)	XXXX/YY/ZZ	XXXX/YY/ZZ
Feedback time monitoring (at safety output ON→OFF)	_____ms	(1) Does F3SX operates normally if the time that elapses from when the safety output is turned ON→OFF until when the feedback input is turned OFF→ON is less than the time you specified? (2) Does F3SX enters the lockout state if the time that elapses from when the safety output is turned ON→OFF until when the feedback input is turned OFF→ON is less than the time you specified?	XXXX/YY/ZZ	XXXX/YY/ZZ
Feedback time monitoring (at safety output OFF→ON)	_____ms	(1) Does F3SX operates normally if the time that elapses from when the safety output is turned OFF→ON until the feedback input is turned ON→OFF is less than the time you specified? (2) Does F3SX enters the lockout state if the time that elapses from when the safety output is turned OFF→ON until when the feedback input is turned ON→OFF is less than the time you specified?	XXXX/YY/ZZ	XXXX/YY/ZZ
Settings for external indicator output	_____	Does the external indicator light on, flash or light off correctly according to the settings?	XXXX/YY/ZZ	XXXX/YY/ZZ
Settings for auxiliary solid-state output	AS1:__ AS2:__ AS3:_____	After completing the setup and when connecting to the function setup supporting software for F3SX again, are the settings shown for the output of the auxiliary solid-state identical to those you actually set?	XXXX/YY/ZZ	XXXX/YY/ZZ

(Cautions)
*When you changed the delay time, you need to re-calculate the safety distance and verify the installation state.
*Log and store the new settings and test results. (The function set-up software for model F3SX can store the data of settings you made. Also, when transferring F3SX, pass the successor the data and contents set in the product. (Print the setup data entry sheet in the next page for use.)

⚠ CAUTION

形F3SX用機能設定支援ソフトにて設定変更した場合、
変更値を記録し、保管ください。
(表1に改訂履歴を記録ください。表2に設定内容を記録ください。)

With the function set-up software for model F3SX,when some setting change are made,please record and keep the change value.
(Please record a revised history on Table 1. Moreover,please record the contents of a setting on Table 2.)

〔表1／Table 1〕

Revision history			
Rev.	Detail	Date	Approval

〔表2／Table 2〕

Model: F3SX - _____

- AS1: _____ - AS2: _____
- AS3: _____

- EL1/EL2: _____ - SS1/SS2: Delay mode _____ Delay time _____ ms

- R1: Delay time _____ ms - R2: Delay time _____ ms
- R1: Delay time _____ ms - R2: Delay time _____ ms

- Threshold value of Cross-channel synchronous monitoring

____ module: _____ ms ____ module: _____ ms
____ module: _____ ms ____ module: _____ ms

- Threshold value of Feedback monitoring

At Safety outputs ON → OFF: _____ ms
At Safety outputs OFF → ON: _____ ms

Routine inspection

Confirm the followings once every 24 hours at the beginning of daily work.

Items to be confirmed	Confirmed
Power of the control system is OFF.	
No person exists in the protection area when operator turns the power ON.	
No external flaws or dents exist on each input device and wires.	
Output is OFF when making each input device into the stop state (OFF-state of output) one after another.	
The routine inspection items specified in the Instruction Manual regarding the safety light curtains and multi-beam safety sensor in use, are satisfied.	
No person can reach the hazardous area without passing through the detection zone.	
The devices are positioned so that they can always detect whole or a part of a human body of a person who works around the hazardous areas.	
The distance to the hazardous areas is more than the minimum safety distance calculated by the given formula.	

(Cautions)

* If any malfunctioning occurs, inspect all the functions of the F3SX and all of input devices.
* Do not re-start the control system until the inspection is completed.

Biannual inspection

Confirm the followings every six months or when setting of the machine has been changed.

Items to be confirmed	Confirmed
The machine is in such a structure that may bother the safety functions such as enforced stop.	
No modification or connection change has been made that affects the control system of the machine badly.	
The output of the input device and the machine are connected by proper wiring.	
Actual response time of the entire machine is normal and shorter than the designed value.	
Accumulated number of switching frequency with each control relay and contact is significantly small compared with those of the life duration.	
No loosened screw exists for fix the brackets.	
No looseness in connector or wiring exists.	

Quoted Standards

International standards

IEC61508-1,2,3,4,5,6,7	Functional safety of electrical/electronic/programmable electronic safety-related systems- Part 1 to 7.
IEC61496-1	Safety of machinery-Electro-sensitive protective equipment-Part 1: General requirements and tests
IEC60664-1	Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests
IEC60742	Isolating transformers and safety isolating transformers. Requirements

European standards

EN 954-1	Safety of machinery-Safety related parts of control systems-Part 1: General principles for design
EN ISO13849-1:2008	Safety of machinery-Safety related parts of control systems-Part 1: General principles for design
EN 50178	Electronic equipment for use in power installations
EN60204-1	Safety of machinery-Electrical equipment of machines-Part 1: General requirements
EN61496-1	Safety of machinery-Electro-sensitive protective equipment-Part 1: General requirements and tests
EN574	Safety of machinery-Two-hand control devices-Functional aspects - Principles for design
EN1760-1	Safety of machinery. Pressure sensitive protective devices. General principles for the design and testing of pressure sensitive mats and pressure sensitive floors
EN1088	Safety of machinery - Interloking devices associated with guards - Principles for design and selection
prEN50156-1	Electrical equipment for furnaces and ancillary equipment - Part 1: Requirements for application design and installation

American standards

UL508	Industrial Control Equipment
UL1998	Software in Programmable Components
UL61496-1	Safety of machinery-Electro-sensitive protective equipment-Part1: General requirements and tests

■ Glossary

▪ IEC61508: 1998 (EN61508:2001)

The standard that specifies the detailed procedures (for designing, evaluation methods, etc.) to be taken in the safety life cycle including designing, installation, maintenance servicing, disposition of the systems or devices in relation to the safety functions which are realized by the electrical/electronic/electronically programmable systems.

▪ SIL: Safety Integrity Level

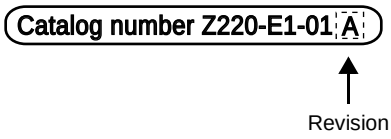
The Safety integrity level of a safety system as represented by a numeric figure likewise the safety category B, 1, 2, 3 or 4 of the conventional EN954-1. The level is set forth by calculated probability of occurrence of hazardous troubles according to the frequency of usage. The F3SX SIL is classified on the safety level same as the safety category 4 of EN954-1.

▪ Performance Level: PL

This is an index that showed the performance of the safety control system that can share by the risk assessment and the mechanical design. It is evaluated from "a" by five stages of "e". The demanded performance level is specially called PLr from the standpoint where the risk assessment is executed. The performance level PL of the safety control system from which the decrease of the risk is attempted should be a level more than the equal to PLr.

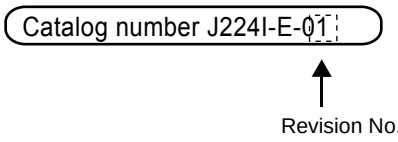
Revision History

The revision symbols of the manual are attached to the catalog number in the lower part of the front cover and back cover.



Revision symbol	Revision date	Revisions
A	February 2005	First edition
B	July, 2009	Added descriptions about safety light curtain Model F3SJ, compliance with EMC Directive, etc.
C	December, 2009	Correspondence from EN954-1 to EN ISO13849-1, compliance with Machinery Directive, etc.
D	February, 2010	Correspondence to EN ISO13849-1:2008, compliance with Machinery Directive, etc.

Americas Edition



Revision symbol	Revision date	Revisions
1	February 2005	Content same as Z220D-E1-01A, Americas contact information

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